MANATŪ HAUORA
MINISTRY OF HEALTH

133 Molesworth Street
PO Box 5013
Wellington 6140
New Zealand
T+64 4 496 2000

19 August 2022

s 9(2)(a)

By email: s 9(2)(a)
Ref: H2022008412

Tēnā koe s 9(2)(a)

Response to your request for official information

Thank you for your request under the Official Information Act 1982 (the Act) to Manatū Hauora (Ministry of Health) on 24 July 2022 for information regarding Long COVID.

s 9(2)(a) If you need personal health information, you can call the COVID Healthline on 0800 3585453 at any time or contact your family doctor. Should you experience a medical emergency, you or anyone assisting in your care should not hesitate to call 111 and ask for an ambulance.

Turning to your request, you asked for:

> *1. Any internal correspondence or documentation discussing matters like;*
> *a. Which government authority/ministry should be in charge of social supports for long covid sufferers.*
> *b. What proposed social supports there should be for long covid sufferers.*
> *c. What medical supports are proposed for long covid sufferers eg: any standardised testing, referrals that should be made.*
> *d. What financial cost will the above medical and social supports entail for not only current long covid sufferers, but future long covid sufferers too.*
> *e. What recommendations have been made by both medical professionals and other health professionals about these supports both social and medical.*

On 3 August 2022, we contacted you in accordance with section 18B of the Act as your request asked for a very large volume of information. You refined your request to the following:

> *Reports, key evidence and documentation regarding:*
> *a. Which government authority/ministry should be in charge of social supports for long covid sufferers.*
> *b. What proposed social supports there should be for long covid sufferers.*
> *c. What medical supports are proposed for long covid sufferers eg: any standardised testing, referrals that should be made.*
> *d. What financial cost will the above medical and social supports entail for not only current long covid sufferers, but future long covid sufferers too.*

e. What recommendations have been made by both medical professionals and other health professionals about these supports both social and medical.

Seven documents have been identified within the scope of your request. The documents are itemised in Appendix 1 and have been released to you in full. These cover literature reviews and research to inform the Manatū Hauora work programme, and a scoping review of current and emerging best practice for Long COVID rehabilitation.

In addition, there is a range of publicly available information that may be of interest:

- Information on the definition, symptoms, treatment and management of Long COVID can be found at: www.health.govt.nz/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.
- Information on Manatū Hauora work on Long COVID, including the scope of the work programme and sector updates can be found at: www.health.govt.nz/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid#understand.
- Guidance for the Acute Phase of Rehabilitation of People with or Recovering from COVID-19 in Aotearoa New Zealand can be found at: www.health.govt.nz/publication/guidance-acute-phase-rehabilitation-people-or-recovering-covid-19-aotearoa-new-zealand.

Additionally, Manatū Hauora expects to publish rehabilitation and service guidelines for Long COVID on its website in the next month.

Given the Ministry of Social Development (MSD) is responsible for social supports, you may wish to contact MSD for additional information at: oia_requests@msd.govt.nz

I trust this information fulfils your request. Under section 28(3) of the Act, you have the right to ask the Ombudsman to review any decisions made under this request. The Ombudsman may be contacted by email at: info@ombudsman.parliament.nz or by calling 0800 802 602.

Please note that this response, with your personal details removed, may be published on the Manatū Hauora website at: www.health.govt.nz/about-ministry/information-releases/responses-official-information-act-requests.

Nāku noa, nā

Martin Chadwick
Chief Allied Health Professions Officer
Allied Health Professions Office

Appendix 1: List of documents for release

#	Date	Document details	Decision on release
1	October 2021	Current and emerging best practice for Long COVID rehabilitation in context of a multidisciplinary team involving allied, scientific, and technical professions: a scoping review	Released in full.
2	January 2022	Request for Advice – Long COVID information for Care in the Community	
3	January 2022	Long COVID Services Report for Northern Region	
4	February 2022	Request for Advice – Long COVID Evidence Update	
5	May 2022	Request for Advice – Long COVID Evidence Update.	
6	July 2022	Request for Advice – Long COVID Evidence Update.	
7	August 2022	Request for Advice – Long COVID Evidence Update.	

Current and emerging best practice for Long COVID rehabilitation in context of a multidisciplinary team involving allied, scientific, and technical professions: a scoping review

Project brief: A scoping review of current and emerging best practice for Long COVID rehabilitation

Purpose: Collate and review the latest and emerging evidence for the rehabilitation of Long COVID, particularly in context of a multidisciplinary team involving allied, scientific and technical professions providing services to consumers who report ongoing symptoms post-acute phase COVID-19.

Background/Rationale:

It is emerging that there is a proportion of individuals who contract COVID-19 develop persistent symptom/s for weeks or months after acute infection. This persistent condition is typically referred to as Long COVID, although a consensus on a definition of Long COVID is lacking. Prevalence and symptomology data are also emerging, but World Health Organization (WHO) estimates 5% of people who have had COVID-19 experience symptoms that continue for at least a month, and 10% continue to experience symptoms after 12 weeks (WHO, Policy Brief 39: IN the wake of the pandemic - Preparing for Long COVID, 2021). Ongoing symptom/s are variable, can affect various body systems, with differing severity

Background and Rationale:

A proportion of individuals who contract COVID-19 develop persistent symptom/s for weeks or months after acute infection. This emerging condition is sometimes referred to as Long COVID, post-COVID syndrome or post-COVID condition; although a consensus on a definition of Long COVID and universally accepted terminology is yet to be released[1]. Prevalence and symptomology data are also emerging, but the World Health Organization (WHO) currently estimates 25% of people who have had COVID-19 experience symptoms that continue for at least a month, and 10% may continue to experience symptoms after 12 weeks (WHO, 2021). Ongoing symptom/s can be variable, and can affect various body systems, with differing severity and courses, such possible symptoms are listed in Appendix A: Commonly reported symptoms of Long COVID .

Global focus was initially on the immediate needs of those hospitalised with acute COVID-19, followed by potential long-term needs post-hospitalisation. It has since been established that a person

[1] Following completion of this review the WHO released a clinical case definition of post COVID-19 condition as per: 'Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms and that last for at least 2 months and cannot be explained by an alternative diagnosis. Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others and generally have an impact on everyday functioning. Symptoms may be new onset following initial recovery from an acute COVID-19 episode or persist from the initial illness. Symptoms may also fluctuate or relapse over time.' (WHO, 2021). This project was developed and completed prior to this clinical case definition.

can experience Long COVID regardless of the severity of the acute-phase illness, and there is an emerging shift in research and literature evaluating the chronic phase of post COVID-19 infection (de Sire, et al., 2021). In other counties with higher infection numbers over the course of the pandemic, there is an increasing awareness and mounting pressure from healthcare professionals and people with ongoing symptoms to be able to access evidence-based support, treatment and/or rehabilitation. In New Zealand, at the time of writing the total number of confirmed cases and burden of the acute illness is currently relatively low compared to internal data (John Hopkins University Research Centre, 2021). In this current context, any recommendations will need to be inclusive of both acute-phase survivors and those who arrive/return who may have had acute COVID infection in overseas. With the eventual re-opening of the New Zealand borders and recent increases in community transmission, the number of people who may potentially suffer from Long COVID in Aotearoa New Zealand is expected to increase. This necessitates the need for these people to access appropriate diagnoses, support, interventions, and rehabilitation.

The 'Guidance for the rehabilitation of people with or recovering from COVID-19 in Aotearoa New Zealand' (Ministry of Health, 2020) is to be updated given emerging evidence post publication. The resources collated and reviewed could be foundational to this document update. The author recognises that given Long COVID is emerging, the review of evidence should be ongoing and iterative. This current review seeks to capture current available published evidence as of 9 July 2021 to 31 August 2021.

Objectives:

A scoping review was conducted to systematically identify and map research around Long COVID rehabilitation with the following objectives:

1. Search, identify, and collate any current and emerging evidence of best practice applied to Long COVID rehabilitation, within a multidisciplinary perspective.
2. Search, identify and collate any multidisciplinary or profession-based clinical guidance/resources for Long COVID rehabilitation.
3. Search, identify and compile available clinical practice resources or tools for Long COVID rehabilitation.
4. Complete a reflexive thematic analysis on sources to identify key themes. These themes will inform a discussion of emerging evidence of best practice applied to Long COVID rehabilitation, within a multidisciplinary perspective and linked to an Aotearoa New Zealand context (where appropriate).

Scope:

Inclusion Criteria (in-scope)

- For the purposes of this review, Long COVID includes both ongoing symptomatic COVID-19 (4-12 weeks post-acute infection) and post-COVID-19 syndrome (≥12 weeks post-acute infection). Regardless of whether the acute COVID-19 infection requiring hospitalisation.

- Long COVID rehabilitation is defined as interventions which aim to restore function across physical, psychological, social and vocational domains when patients experience ongoing or persistent symptoms related to COVID-19 infection.
- Allied health, scientific and technical are qualified health professionals with specialist expertise in preventing, diagnosing, treating, and rehabilitating a range of conditions and illnesses, including the rehabilitation of Long COVID.
- As rehabilitation typically requires a multi-disciplinary and interprofessional approach tailored to an individual, allied health professions may include: Physiotherapists, Occupational Therapists, Dieticians, Clinical Exercise Physiology, Psychologists/Counsellors, Social Workers, Speech Language Therapists, Audiologists.
- Any sources offering indigenous, cultural, or ethnicity-based evidence or views on Long COVID rehabilitation.

Exclusion Criteria (out-of-scope)

- Self-management advice and guidance for post-acute COVID-19 recovery following hospital discharge.
- Medical management and treatment of COVID-19, including appropriate initial investigation/s to rule out acute or life-threatening complications and alternative diagnoses.
- Pharmacological treatments and approaches to COVID-19 or Long COVID.

Methods

Protocol

A scoping review was completed using the principles of the PRISMA-ScR and JBI methodology processes (Tricco, et al., 2018; Peters, McInerney, Munn, Tricco, & Khalil, 2020). Given the emerging nature of Long COVID as a condition requiring rehabilitation, a scoping review approach was selected to systematically synthesize and map emerging knowledge and evidence to identify main concepts, themes, reference sources, and/or knowledge gaps. The objectives, inclusion criteria and methods for this scoping review were specified in advance, then reviewed and approved by the Ministry of Health Chief Allied Health Professions Office.

Eligibility criteria and Information Sources

Unrestricted source type was utilised due to the emerging nature of Long COVID rehabilitation and as this is an initial scoping review. The search strategies were drafted by an experienced Ministry of Health Senior Reference Librarian in consultation with the researcher. The initial database search was conducted by the Senior Reference Librarian sourcing from Ovid MEDLINE(R) and Epub databases. Sources were required to be written in English and published up until 9 July 2021. Sources included empirical papers (Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations). The search strategy is reported in Appendix B: Search Strategy Search results were exported to Microsoft Word by the Librarian, with any identified duplicates removed. The search was supplemented by researcher scanning of reference lists of relevant reviews and sources. Sources

were excluded by the researcher if they did not meet the eligibility criteria as previously defined. Sources were collated and data extracted by the researcher over between 9th July to 31st August 2021.

Search

Full details on the search strategy are reported in Appendix B: Search Strategy. Keywords: Long COVID, post-COVID (-19) syndrome, chronic COVID(-19) syndrome, chronic COVID(-19) syndrome, long-hauler, post-COVID(-19) conditions, post COVID(-19), long-term effect COVID, prolonged COVID, lasting COVID, post-discharge COVID, post-acute COVID, ongoing symptomatic COVID(-19). rehabilitation, management, mental health or psychosocial support, multidisciplinary or therapy or therapies or integrated or multi-disciplinary, physical or occupational or speech or diet therapy, respiratory, therapy.

Selection of sources of evidence

Review of evidence was conducted by a single reviewer who is an allied health professional. The data selection process and data charting tool was drafted by the reviewer, evaluated and reviewed by the Ministry of Health Clinical Principal Advisor, and subsequently approved by the Ministry of Health Chief Allied Health Professions Officer. The reviewer sequentially evaluated the titles, abstracts and full texts of all sources identified.

Data items and charting process

A data-charting tool and record was developed by the reviewer in a Microsoft Excel Workbook format to extract the identified relevant variables. Data were extracted independently by a single reviewer. The data-charting record was updated in an iterative process to ensure it was fit for purpose. A full source record was kept with details of all identified sources including a brief exclusion reason. This was useful given the additional reference scanning approach to identify previously identified and avoid charting duplication. The need for a 'secondary theme' was identified early in the charting process and added, as sources often held data on more than one theme. Appendix C: Data Characteristics Extracted via Data Charting Tool outlines details of data and reference characteristics extracted. In cases of inclusion ambiguity, discussion and advice were sought from the Ministry of Health Clinical Principal Advisor and/or Ministry of Health Chief Allied Health Professions Officer. Aside from categorising source type (refer Appendix C: Data Characteristics Extracted via Data Charting Tool), no formal critical appraisal of individual sources of evidence was completed; reflecting that this is an initial scoping review with an emerging body of knowledge for an emerging condition.

Synthesis of results

As the sources were charted a reflexive thematic analysis was completed. The reviewer assessed the literature source and used subjective analysis to determine the main theme, as defined as the main topic or idea in the source relevant to the coping review objectives and inclusion criteria. There was an *a priori* understanding of the emerging evidence for Long COVID rehabilitation suggesting some likely themes would emerge (e.g., Best practice, Multidisciplinary, Rehabilitation tools, Technology).

As a reflexive and iterative theming approach was used, the newly identified themes were updated to eight (8) identified themes of the sources. The processed and synthesised charted evidence was converted into a diagrammatic form to represent the themed outcomes identified, multidisciplinary or profession-based clinical guidance/resources, and identified clinical practice resources or tools for Long COVID rehabilitation.

Results

1. Scoping review completed to identify and collate current and emerging evidence of best practice applied to Long COVID rehabilitation, within a multidisciplinary perspective.

The scoping review process and sources identified, assessed for eligibility, and included for data extraction are illustrated in Figure 1: PRISMA style flow diagram. Adapted from

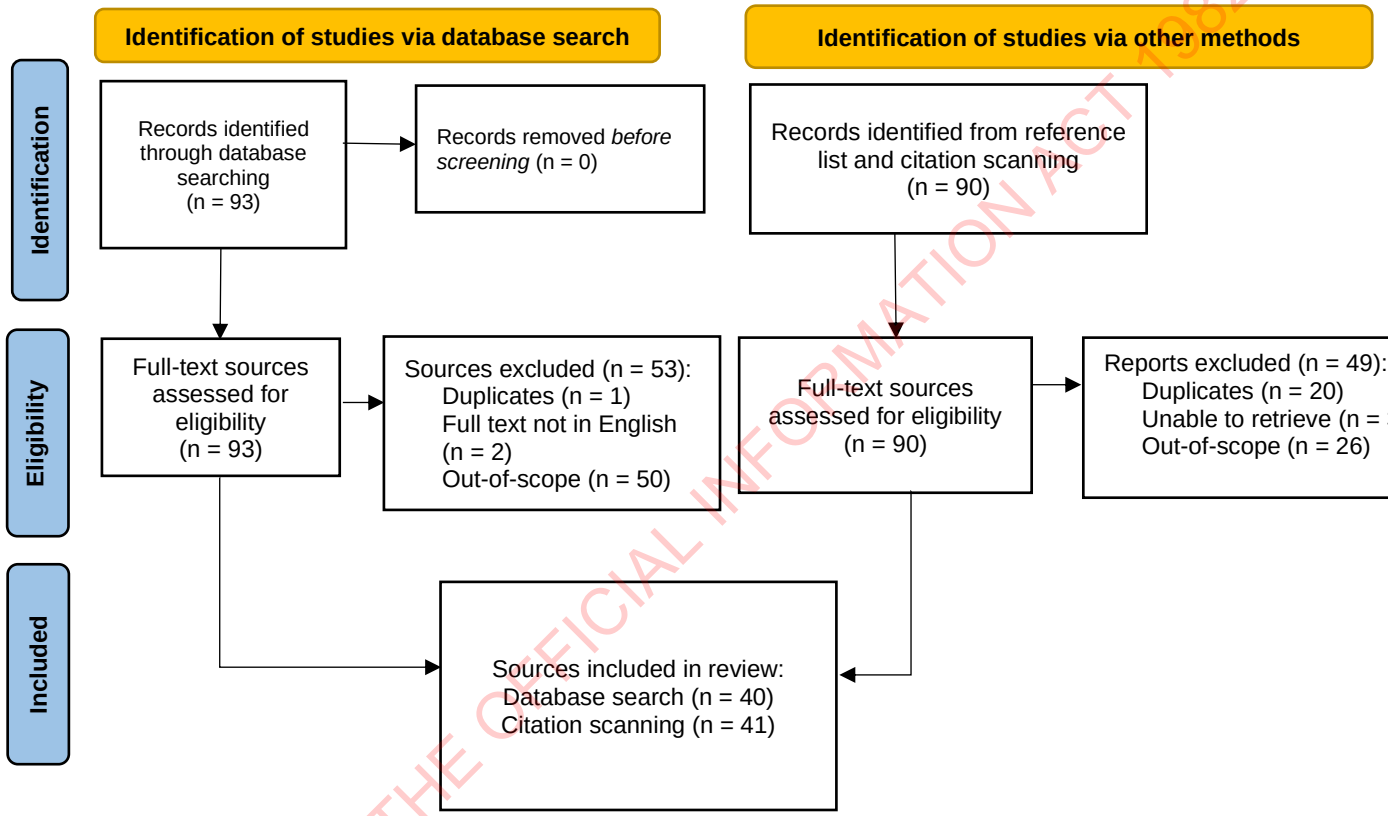


Figure 1: PRISMA style flow diagram. Adapted from (Tricco, et al., 2018)

An overview of the different source types included in the data extraction is depicted in Table 1: Included Source Typesbelow, the most common sources included were journal articles and websites.

Table 1: Included Source Types

Source Type	Total Number of Sources
Book Section	1
Journal Article	34
Journal - Ahead of print	2
Journal Article - In-process	2
Journal Article - In-data-review	1
Online Document	3
Website	21
Commentary	3
Letter to the Editor	4
Guideline	7
Editorial	3
Total	81

Table 2 All sources and themes identified

Search	Source	Source/Evidence Type	Country of Origin	Title	Primary Theme	Secondary Theme
MOH Librarian - 1st Search 9/7/21	(NICE, 2020)	Guideline	UK	COVID-19 rapid guideline: managing the long-term effects of COVID-19	Best Practice/Suggested Management	Multidisciplinary
MOH Librarian - 1st Search 9/7/21	(Dani, et al., 2021)	Journal Article	UK	Autonomic dysfunction in 'Long COVID': rationale, physiology and management strategies	Best Practice/Suggested Management	
MOH Librarian - 1st Search 9/7/21	(Daynes, Gerlis, Chaplin, Gardiner, & Singh, 2021)	Journal Article	UK	Early experiences of rehabilitation for individuals post-COVID to improve fatigue, breathlessness exercise capacity and cognition - A cohort study	Best Practice/Suggested Management	Rehabilitation tools
MOH Librarian - 1st Search 9/7/21	Décary, S., et al	Editorial	Canada	Humility and Acceptance: Working within Our Limits with Long COVID and Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome	Best Practice/Suggested Management	Rehabilitation tools
MOH Librarian - 1st Search 9/7/21	Funke-Chambour, M., et al.	Guideline	Switzerland	Swiss Recommendations for the Follow-Up and Treatment of Pulmonary Long COVID.	Best Practice/Suggested Management	
MOH Librarian - 1st Search 9/7/21	Garcia-Molina, A., et al.	Letter to the Editor	Spain	Neuropsychological rehabilitation program for patients with post-COVID-19 syndrome: A clinical experience.	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	NHS	Website	UK	When Do I Need To Seek Help?	Best Practice/Suggested Management	Model of Care
MOH Librarian - 1st Search 9/7/21	Hayden, M., et al.	Journal - Ahead of print	Germany	Short-term Effects of a Three-week Inpatient Post-COVID-19 Pulmonary Rehabilitation Program - a Prospective Observational Study	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	Malnutrition Pathway UK	Website	UK	Managing Adult Malnutrition	Best Practice/Suggested Management	
MOH Librarian - 1st Search 9/7/21	Liska, D. and M. Andreansky	Journal Article	Slovakia	Rehabilitation and physical activity for COVID-19 patients in the post infection period	Best Practice/Suggested Management	
MOH Librarian - 1st Search 9/7/21	Mayer, K. P., et al.	Journal Article	USA	Physical Therapy Management of an Individual With Post-COVID Syndrome: A Case Report	Best Practice/Suggested Management	Rehabilitation tools
MOH Librarian - 1st Search 9/7/21	Scordo, K. A., et al.	Journal Article	USA	Post-COVID-19 Syndrome: Theoretical Basis, Identification, and Management.	Best Practice/Suggested Management	Model of Care
MOH Librarian - 1st Search 9/7/21	Singh, S. J., et al.	Journal Article	UK	The British Thoracic Society survey of rehabilitation to support recovery of the Post Covid-19 population,	Best Practice/Suggested Management	[Integrated] Care Pathway
MOH Librarian - 1st Search 9/7/21	Vanichkachorn, G., et al.	Journal Article	USA	Post–COVID-19 Syndrome (Long Haul Syndrome): Description of a Multidisciplinary Clinic at Mayo Clinic and Characteristics of the Initial Patient Cohort	Best Practice/Suggested Management	Multidisciplinary
MOH Librarian - 1st Search 9/7/21	Vink, M. and A. Vink-Niese	Journal Article	Germany & Nederland	Could cognitive behavioural therapy be an effective treatment for Long COVID and post covid-19 fatigue syndrome? Lessons from the qure study for q-fever fatigue syndrome.	Best Practice/Suggested Management	
MOH Librarian - 1st Search 9/7/21	Yong, S. J.	Journal Article	Malaysia	Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	Barker-Davis et al.	Journal Article	UK	The Stanford Hall consensus statement for post-COVID-19 rehabilitation	Best Practice/Suggested Management	Multidisciplinary
Reference list scan - MOH librarian 1st search 9/7/2021	Gorna R et al.	Commentary	UK	Long COVID guidelines need to reflect lived experience	Best Practice/Suggested Management	Guideline
Reference list scan - MOH librarian 1st search 9/7/2021	Spruit et al.	Journal Article	International	COVID-19: Interim Guidance on Rehabilitation in the Hospital and Post-Hospital Phase from a European Respiratory Society and American Thoracic Society-coordinated International Task Force.	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	NICE	Online Document	UK	Statement about graded exercise therapy in the context of COVID-19. In: Myalgic encephalomyelitis (or encephalopathy)/chronic fatigue syndrome: diagnosis and management (in development GID-NG10091).	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	Puchner, B. et al	Journal Article	Austria	Beneficial effects of multi-disciplinary rehabilitation in post-acute COVID-19—an observational cohort study	Best Practice/Suggested Management	Multidisciplinary
Reference list scan - MOH librarian 1st search 9/7/2021	Liu K, et al.	Journal Article	China	Respiratory rehabilitation in elderly patients with COVID-19: a randomized controlled study.	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	Chartered Society of Physiotherapy	Website	UK	Long COVID	Best Practice/Suggested Management	Rehabilitation tools
Reference list scan - MOH librarian 1st search 9/7/2021	Long COVID Physio	Website	International	Long COVID Physio Resources	Best Practice/Suggested Management	Rehabilitation tools
Reference list scan - MOH librarian 1st search 9/7/2021	World Physiotherapy	Website	International	Rehabilitation and Long COVID World PT day 2021	Best Practice/Suggested Management	
Reference list scan - MOH librarian 1st search 9/7/2021	Sindh et al.	Guideline	UK	Delivering rehabilitation to patients surviving COVID-19 using an adapted pulmonary rehabilitation approach – British Thoracic Society guidance	Best Practice/Suggested Management	[Integrated] Care Pathway
Reference list scan - MOH librarian 1st search 9/7/2021	Physiopedia	Website	UK	Long COVID	Best Practice/Suggested Management	

2. Identified Multidisciplinary or profession based clinical guidance/resources for Long COVID rehabilitation

	Topic	Authors	Source Type	Title	URL	Summary
Multidisciplinary	Professional resource or Framework	NICE (2020)	Guideline	COVID-19 rapid guideline: managing the long-term effects of COVID-19	https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-66142028400325	Developed collaboratively by NICE, the Scottish Intercollegiate Guidelines Network (SIGN) and the Royal College of General Practitioners (RCGP). Living guideline. Developed for health and care practitioners, staff involved in planning and delivering services, commissioners. Includes advice for primary care or community settings, diagnostic investigations (supports wholistic assessments) and referral pathways. Provides advice on self-management and self-supported management, MDT referral for rehabilitation, suggested follow-up and monitoring, sharing information and continuity of care, and service organisation. Considers children. No advice on specific rehabilitation, but supports the provision of an 'integrated, multidisciplinary rehabilitation services, based on local need and resources.' Suggests a core team of occupational therapy, physiotherapy, clinical psychology and psychiatry, rehabilitation medicine.
	Professional resource or Framework	Nurek et al., (2021)	Journal – Ahead of Print	Recommendations for the Recognition, Diagnosis, and Management of Patients with Post COVID-19 Condition ('Long COVID'): A Delphi Study	https://dx.doi.org/10.2139/ssrn.3822279	Aims to provide a rapid expert guide for Post Covid-19 Condition. Panel of UK Doctors generated 33 recommendations via Delphi testing, pertaining to the recognition, investigation, and management of Long COVID. Recommended Long COVID clinics need to operate not in isolation but in the context of rapidly evolving practice amongst both GPs and specialists. Argues for GP or specialist focused approach and identified need for care pathways, investigations of specific complications, management of potential symptoms, and individualised rehabilitation. Supports onward referral medically-led MDT clinic as needed.
	Professional resource or Framework	Barker-Davis et al., (2020)	Journal Article	The Stanford Hall consensus statement for post-COVID-19 rehabilitation	http://dx.doi.org/10.1136/bjsports- 2020-102596	Early consensus statement on overarching framework assimilating evidence and likely requirements of multidisciplinary rehabilitation post COVID-19 illness, for a target population of active individuals, including military personnel and athletes. Developed by an expert panel and appraised evidence relating to COVID-19 rehabilitation requirements: pulmonary, cardiac, psychological, musculoskeletal, neurorehabilitation and general medical. Specific recommendations provided on General, Pulmonary, Cardiac, Exercise, Psychological, Musculoskeletal, Neurological, Medical. Supports needs for further research.
	General or Public Resource	NHS (n.d.)	Website	When Do I Need To Seek Help?	https://www.yourcovidrecovery.nhs.uk/your-road-to-recovery/when-do-i-need-to-seek-help/	Public information resource when to seek help, where to go, and what might happen. NHS-based information. Suggests GP initial assessment, then onwards referral to Post COVID clinics as appropriate.
	Primary Care	Greenhalgh et al., (2020)	Journal Article	Management of post-acute covid-19 in primary care	http://dx.doi.org/10.1136/bmj.m3026	Primary care management advice-practice, links to patient and professional references and mentions social and cultural considerations. Provides 1-page visual summary of post-acute management in primary care. Supports managing co-morbidities, examination, assessing social and financial circumstances, and self and/or medical management.
	Primary Care	Shah, Hillman, Playford, & Hishmeh (2021)	Journal Article	Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline	https://dx.doi.org/10.1136/bmj.n136	Summary of NICE, SIGN, RCGP guidelines. Primary care and medical emphasis. Summarises: Investigation and referral, planning care, management, follow up and monitoring, sharing information and continuity of care, service organisation. Management can include self and supported self-management, supporting phase return to work, track symptoms with symptom diaries. Supports multidisciplinary rehabilitation for physical, psychological and psychiatric aspects. Supports primary care follow-up plan, and shared decision making.
	Post-COVID Clinic Example	Vanichkachorn et al., (2021)	Journal Article	Post–COVID-19 Syndrome (Long Haul Syndrome): Description of a Multidisciplinary Clinic at Mayo Clinic and Characteristics of the Initial Patient Cohort	https://dx.doi.org/10.1016/j.mayocp.2021.04.024	Describe characteristics of the first 100 at the Mayo Clinic multi-disciplinary COVID-19 Activity Rehabilitation Program (CARP). Program has medical and allied health professionals, with activity program elements with standard and optional as required. Self-referred, 68% female, average age = 45 years with most not being hospitalised in the acute phase. Common presenting symptoms ware fatigue (80%), respiratory complaints (59%), and neurological complaints (59%) followed by subjective cognitive impairment, sleep disturbance, and mental health symptoms. For most patients, laboratory and imaging tests showed no abnormalities or were nondiagnostic despite debilitating symptoms. Most patients required physical therapy, occupational therapy, or brain rehabilitation – focusing therapy as a individually paced program. Face-to-face and virtual care delivery modalities offered feasible.
	Post-COVID Clinic Example	Santhosh et al., (2021)	Journal Article - In-process	Rapid Design and Implementation of Post-COVID-19 Clinics.	https://dx.doi.org/10.1016/j.chest.2021.03.044	Describes design and implementation of multidisciplinary post-COVID-19 clinics in US. Highlight components of the model, while acknowledging opportunities to tailor offerings to the local institutional context. Aims to provide a replicable framework for others. Collaboration between John Hopkins (PACT Clinic) and University of California-San Francisco hospital (OPTIMAL clinic). Considers addressing social determinants of health and health equity. Large urban academic medical centres, however, telemedicine has allowed care for rural communities. Aimed to support primary care (not replace). Provides specific information on clinic organisation.
Physiotherapy-based	Orthostatic Intolerance	Dani et al. (2021)	Journal Article	Autonomic dysfunction in 'Long COVID': rationale, physiology and management strategies	https://dx.doi.org/10.7861/clinmed.2020-0896	Argues Long COVID may be explained by autonomic instability and may result in orthostatic intolerance syndrome. Suggested treatment/management of orthostatic intolerance syndrome that could be used to help specific symptoms of Long COVID (breathlessness, palpitations, fatigue, chest pain, presyncope or syncope). UK Tertiary syncope: 6 case studies, female 26-50 years old confirmed or suspected COVID-19. Specific management approaches suggested for orthostatic intolerance treatment that could be used for Long COVID specific symptoms (breathlessness, palpitations, fatigue, chest pain, presyncope or syncope): Education, Exercise (regular, structures non-upright aerobic and resistance), Fluid and Salt repletion, avoiding exacerbating factors, isometric exercises, and compression garments.
	Respiratory Rehabilitation	Daynes et al. (2021)	Journal Article	Early experiences of rehabilitation for individuals post-COVID to improve fatigue, breathlessness exercise capacity and cognition - A cohort study	https://dx.doi.org/10.1177/14799731211015691	Modified Pulmonary Rehabilitation Program (Exercise &Education). Small (n = 30 (52% male, mean age 58 years) observational study; 6 week rehabilitation programme two supervised sessions/week. including aerobic exercise (walking/treadmill based), strength training of upper and lower limbs and educational discussions with handouts from the www.yourcovidrecovery.nhs.uk website. Pacing advice was provided and reinforced alongside the exercise component. Improved breathlessness, fatigue and cognition and statistically significant improvements in exercise capacity, respiratory symptoms, fatigue and cognition. No serious adverse events recorded,
	Respiratory Rehabilitation	Funke-Chambour, M., et al. (2021)	Journal Article	Swiss Recommendations for the Follow-Up and Treatment of Pulmonary Long COVID.	https://dx.doi.org/10.1159/000517255	Swiss COVID Lung Study Special Interest Group survey developed interim recommendations. Strong recommendations that persistent respiratory symptoms after COVID-19 should be investigated by a pulmonary follow-up (states specific medical assessments e.g., Chest X-ray). People with Long COVID are recommended to have access to specialised MDT post-COVID clinics or networks, with medical and allied health (e.g., Physiotherapy). Evidence for the management and treatment of pulmonary manifestations of Long COVID still lacking.
	Respiratory Rehabilitation	Hayden et al. (2021)	Journal Article – Ahead of Print	Short-term Effects of a Three-week Inpatient Post-COVID-19 Pulmonary Rehabilitation Program - a Prospective Observational Study	https://doi.org/10.21203/rs.3.rs-578230/v1	Evaluated the feasibility, safety, and efficacy of post-COVID-19 3-week tailored pulmonary rehabilitation (PR). German prospective observational study. n = 108 (male = 54.6%, mean age 55.6 years). Improvements in dyspnoea, physical capacity, quality of life, fatigue, and depression. Patients with severe forms of COVID-19 showed greater improvements, especially if the beginning of treatment occurs soon after the acute phase. Concludes PR is feasible, safe, and effective after acute COVID-19, with a trend toward greater efficacy after severe courses of COVID-19 and an earlier start of PR.
	Respiratory Rehabilitation	Singh, S. J., et al. (2020)	Journal Article	The British Thoracic Society survey of rehabilitation to support recovery of the Post Covid-19 population	https://dx.doi.org/10.1136/bmjopen-2020-040213	Rapid survey April 2020 to identify the components of a post-Covid-19 rehabilitation programme to inform service delivery. British Thoracic Society members and multi-professional clinicians, across specialities contributed (n = 103). A 6-8-week follow-up assessment was considered important, focusing on the assessment of a broad range of possible symptoms and identifying individual rehabilitation needs. Components recommended: advice to return to usual exercise habits, advice for home-based aerobic and resistance programs, fatigue and mood disturbance advice, breathless advice, and return to work advice. Recommended adapting well established (pulmonary rehabilitation) services to accommodate needs, and integration with other specialities as needed.
	Respiratory Rehabilitation	Spruit et al. (2020)	Journal Article	COVID-19: Interim Guidance on Rehabilitation in the Hospital and Post-Hospital Phase from a European Respiratory Society and American Thoracic Society-coordinated International Task Force.	https://doi.org/10.1183/13993003.02197-2020	Interim recommendations for rehabilitation in hospital and post-hospital phases, based on 93 experts via convergence of opinion. Mainly respiratory focused. Recommends follow-up 6-8 weeks post-discharge of rehabilitation needs, with interim low-moderate physical exercise at home. Based on the deficits identified multidisciplinary rehabilitation should be offered with attention for skeletal muscle and functional as well as mental restoration. Argues pulmonary rehabilitation model may suit as a framework.
	Respiratory Rehabilitation	Liu K, et al. (2020)	Journal Article	Respiratory rehabilitation in elderly patients with COVID-19: a randomized controlled study.	https://doi.org/10.1016/j.ctcp.2020.101166	Open randomised controlled trial 6 week respiratory rehabilitation. Intervention group n = 36, average age 69, 67% male. Control group n = 36, average age = 69, 69% male. Program included: respiratory muscle training, cough exercise, diaphragmatic training, stretching exercise, and home exercise. Results showed improved respiratory function and exercise endurance function, quality of life and anxiety in elderly patients with COVID-19 (with no significant improvement in elderly depressive state and activities of daily living) .
	Journal of Clinical Medicine	Postigo-Martin, P., et al. (2021)	Journal Article	A COVID-19 Rehabilitation Prospective Surveillance Model for Use by Physiotherapists	https://dx.doi.org/10.3390/jcm10081691	Proposes a Physiotherapy Surveillance Model for early detection that allows intervention by physiotherapists. Includes face-to-face and tele options Expert panel physiotherapists developed proposed model included: rapid screening to rule out re-infection, general assessment, simple assessments to detect any other conditions. Suggests pulmonary rehabilitation and respiratory muscle training useful management. Pathway untested and unvalidated. Physiotherapist-based model to refer onto other specialists as needed.
	Respiratory Rehabilitation	Singh et al. (2020)	Guideline	Delivering rehabilitation to patients surviving COVID-19 using an adapted pulmonary rehabilitation approach – British Thoracic Society guidance	https://www.brit-thoracic.org.uk/document-library/quality-improvement/covid-19/pulmonary-rehabilitation-for-covid-19-patients/	UK-based guidance focuses on how pulmonary rehabilitation services may adapt to accommodate the needs of the post-acute COVID-19 patient. Provides advice and considerations for setting up post-COVID pulmonary rehabilitation, includes suggested pathway and COVID specific considerations e.g., PPE.

	Exercise - Pacing	Décary, S., et al (2021)	Editorial	Humility and Acceptance: Working within Our Limits with Long COVID and Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome	https://www.jospt.org/doi/pdf/10.2519/jospt.2021.0106	Editorial based on clinical experience/observations of individuals with Long COVID who completed exercise rehabilitation who experienced adverse effects from exercise therapy, similar symptoms to myalgic encephalomyelitis (ME). Cautions exercised-based rehabilitation and risk for post-exertional malaise. Issue safety recommendations for rehabilitation and share resources to improve care for those with post viral illnesses. Suggests two patient safety-actions 1) Screen and continuously monitor for Post-exertional malaise. 2) Promote message "stop, rest, pace" - pacing suggested as important.
	Exercise-based rehabilitation	Liska, D. and M. Andreansky (2021)	Journal Article	Rehabilitation and physical activity for COVID-19 patients in the post infection period	https://dx.doi.org/10.4149/BLL_2021_052	Rehabilitation therapies may help to restore physical function in patients and to reduce the long-term effects of COVID19 infection Review Article - respiratory-related disorders. Suggests functional examination approaches in post-acute phase: six-minute walk test, the chair-stand test, step test, timed up and go test, post-COVID functional status. Also suggests rehabilitation options: aerobic exercise, graded exercise. Also rehabilitation methods: Occupational therapy, psychological care, pulmonary rehabilitation. Lacks reference or rationale for recommendations.
	Exercise-based rehabilitation	Mayer, K. P., et al. (2021)	Journal Article	Physical Therapy Management of an Individual With Post-COVID Syndrome: A Case Report	https://dx.doi.org/10.1093/ptj/pzab098	Case report. Clinical presentation and physical therapist management for a patient with post-COVID syndrome. A 37-year-old woman mild acute COVID who experienced persistent symptoms, including dyspnoea, headaches, and cognitive fog. Previously fit and active. OP physical therapist evaluation showed deficits in exercise capacity, minor reductions in muscle strength and cognitive function, and provisional diagnosis of posttraumatic stress disorder (PTSD). Pulmonary rehabilitation clinic 10 weeks post diagnosis. Rehabilitation sessions (8 weeks) structured to include aerobic training, strength training, breathing techniques with mindfulness training, education, and home exercise plan. Educated on energy conservation. Experienced bouts of reduced participation with worsening symptoms of headaches, dyspnoea, fatigue. Improved physical function, but emotional and health-related quality of life no different or worse. Persisting symptoms 4 months on, referred for cognitive rehabilitation (occupational therapy led). Cautions rehabilitation clinicians to consider physiological response to exercise and the implications of post-exertional malaise and fatigue, as well as emotional and cognitive function in management
	Fatigue management and Exercise	Scordo, K. A., et al. (2021)	Journal Article	Post-COVID-19 Syndrome: Theoretical Basis, Identification, and Management.	https://dx.doi.org/10.4037/aacnacc2021492	Discussed possible aetiology of post viral syndromes, describes reported symptoms and suggested management of post-COVID syndrome. Review, expert opinion piece with medical view focussed. Suggests fatigue may be improved with assistance from physical therapists and exercise physiologists. Suggests an exercise program should involve strengthening, flexibility exercises, aerobic exercises, and exercises intended to improve gait and balance. Patients should start slowly and be monitored for worsening symptoms such as breathlessness and muscle aches. In addition to exercise training, patients with significant respiratory symptoms may also benefit from pulmonary rehabilitation programs. Supports various program virtual models, including video-linked classes, printed materials, and telephone support.
	Exercise-based rehabilitation	Yong, S. J. (2021)	Journal Article	Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments	https://doi.org/10.1080/23744235.2021.1924397	Review article. Suggests preliminary evidence suggests that personalized rehabilitation training may help certain Long COVID cases. Light aerobic paced exercise for 6 weeks, multiple daily breathing exercises, and psychological support for fatigue and breathing symptoms. Warns of rehabilitation and potential risks of symptom re-lapse; specially warns to be aware of post-exertional malaise and postural orthostatic tachycardia syndrome.
	Exercise - Graded	NICE (2020)	Online Document	Statement about graded exercise therapy in the context of COVID-19. In: Myalgic encephalomyelitis (or encephalopathy)/chronic fatigue syndrome: diagnosis and management (in development GID-NG10091).	https://www.nice.org.uk/guidance/gid-ng10091/documents/statement	States 'NICE's guideline on ME/CFS (CG53) was published in 2007, many years before the current pandemic and it should not be assumed that the recommendations apply to people with fatigue following COVID19'. Refers for NHS England COVID-19 aftercare guidance.
	General Physiotherapy	Chartered Society of Physiotherapy (Accessed 31/8/2021)	Website	Long COVID	https://www.csp.org.uk/news/coronavirus/clinical-guidance/long-covid	UK-based professional body website clinical guidance Long COVID for Physiotherapists (generic guidance). States good rehabilitation must be safe. Recommends: screen for cardiac damage first, screen for post exertional symptom exacerbation or post exertional malaise. Advises early intervention should aim to stabilise symptoms and establish baseline, activity diaries recommended, and personalised approach is needed. Suggest C19-YRS rehabilitation needs screening tool. Links to https://www.physio-pedia.com/Long_COVID which has online courses for Long COVID and COVID rehabilitation program (member access required).
	General Physiotherapy	Long COVID Physio (Accessed 21/8/2021)	Website	Long COVID Physio Resources	https://longcovid.physio/resources	International peer support, education and advocacy, patient-led association of Physiotherapists living with Long COVID and allies. Website which pulls together professional resources and guidance, physiotherapy focus. Topics include: rehabilitation (https://longcovid.physio/rehabilitation), exercise (https://longcovid.physio/exercise) , fatigue (https://longcovid.physio/fatigue), post-exertional symptom exacerbation, pacing. Links with World Physiotherapy Briefing paper. Promotes stop, rest, pace.
	General Physiotherapy	World Physiotherapy (Accessed 31/8/2021)	Website	World Physiotherapy response to COVID-19 Briefing paper 9. Safe Rehabilitation Approaches for People Living with Long COVID: Physical Activity and Exercise.	https://world.physio/sites/default/files/2021-06/Briefing-Paper-9-Long-Covid-FINAL-2021.pdf	Physiotherapist focused. Exercise and physical activity safe rehabilitation Briefing paper developed with Long COVID Physio, key opinion leaders and stakeholder's (international collaboration). Key messages are safe rehabilitation: screen for post-exertional symptom exacerbation, exclude cardiac impairment first, excludes oxygen desaturation, screen for autonomic dysfunction and orthostatic intolerances. Promotes Stop. Rest. Pace. Also supports person centred approach.
	General Physiotherapy	World Physiotherapy (Accessed 31/8/2021)	Website	Rehabilitation and Long COVID World PT day 2021	https://world.physio/sites/default/files/2021-06/WPTD2021-InfoSheet2-RehabandLongCOVID-Final-A4-v1a.pdf	Summary poster for Long COVID rehabilitation: education, paced, individualised. Patient information poster. Individualised and effective rehabilitation interventions to support self-management of symptoms may include activity pacing, heart rate monitoring. Graded exercise should not be used especially when post-exertional symptom exacerbation present.
	General Physiotherapy	Physiopedia (Accessed 31/8/2021)	Website	Long COVID	https://www.physio-pedia.com/Long_COVID	UK charity for physiotherapy knowledge online resource. Two online courses (access dependent): 'Long COVID: what is it, how to manage, intervention, debate about physical activity' and 'COVID-19 rehabilitation program'.
	General Physiotherapy	Canadian Physiotherapy Association (Accessed 31/8/2021)	Guideline	Rehabilitation for Clients with Post COVID-19 Condition (Long COVID): Guidance for Canadian Rehabilitation and Exercise Professionals.	https://physiotherapy.ca/rehabilitation-clients-post-covid-19-condition-long-covid	Living guideline for Canadian Physiotherapists. Combined resources to inform clinical decision making. Identifies screening advice and where to onwards refer in addition to general advice. Links to relevant sources. Guide for safe rehabilitation, informed by World Physios Briefing paper.
Occupational Therapy	Profession-specific	Royal College of Occupational Therapists (accessed 31/8/2021)	Website	A quick guide for occupational therapists: Rehabilitation for people recovering from COVID-19	https://www.rcot.co.uk/sites/default/files/Quick%20guide%20for%20OTs%20People%20recovering%20from%20COVID-19.pdf	UK-based professional guide. Argues as experts in rehabilitation, occupational therapists have a vital role for COVID-19 rehab for both post-hospital and community care. Provides practical checklist for potential rehabilitation needs to plan/structure occupational therapy provision. Supports person-centred principles needed and suggests services are structured using specialist, targeted, universal approach.
	Profession-specific and public advice	Royal College of Occupational Therapists (accessed 31/8/2021)	Website	Post-COVID Syndrome (Long COVID)	https://www.rcot.co.uk/post-covid-syndrome-long-covid	UK-based. Range of resources for Occupational therapists and also public, with some collaboration with Physiotherapy. Energy conversation resources: https://www.rcot.co.uk/how-manage-post-viral-fatigue-after-covid-19 and https://www.rcot.co.uk/recovering-covid-19-post-viral-fatigue-and-conserving-energy
Dietetics and Nutrition	General or Public Resource	Malnutrition Pathway UK (Accessed 11/82021)	Website	Managing Adult Malnutrition	https://www.malnutritionpathway.co.uk/covid19	Managing Adult Malnutrition. UK - resource for public about nutrition post COVA UK-based overview with useful resources for patients and carers. Endorsed by the British Dietetic Association (BDA), the Royal College of Nursing (RCN) and the British Association of Parenteral and Enteral Nutrition (BAPEN).
Psychological	Neuropsychological	Garcia-Molina, A., et al (2021)	Letter to the Editor	Neuropsychological rehabilitation program for patients with post-COVID-19 syndrome: A clinical experience.	https://doi.org/10.1016/j.nrleng.2021.03.003	Neuropsychological rehabilitation program may help to improve mood and cognition symptoms. n = 50 (46% male, mean age 53.3 years). Mix of hospitalised (ICU and ward) and non-hospitalised patients; 8 week out-patient neurorehabilitation program of respiratory therapy, physical therapy, neuropsychological rehabilitation (mood intervention, compensatory strategies and cognitive therapy). Improvements in memory tasks after treatment, likelihood of anxiety or depression also reduced. No control group and author part-owns cognitive behaviour software used.
	Cognitive Behavioural Therapy	Vink, M. and A. Vink-Niese (2020)	Journal Article	Could cognitive behavioural therapy be an effective treatment for Long COVID and post covid-19 fatigue syndrome? Lessons from the qure study for q-fever fatigue syndrome.	https://dx.doi.org/10.3390/healthcare8040552	Some argue Cognitive behavioural therapy (CBT) could be an effective treatment for Long COVID and post-COVID-19 fatigue syndrome based on claims that it is effective for myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS). This study re-analysed the Dutch Qure study (which studied the efficacy of CBT in a homogeneous group of patients who developed Q-fever fatigue syndrome) and concluded the Qure study suffered from many serious methodological problems and showed that CBT did not lead to objective improvements nor restore the ability to work so then argue CBT 'unlikely that CBT will reduce disability or lead to objective improvement in Long COVID or in post-COVID-19 fatigue syndrome.'

3. Clinical practice resources or tools for Long COVID rehabilitation

Table 3: Identified sources with clinical practice tools or resources

	Authors	Source Type	Title	URL	Description
Long COVID – general or combined advice	Homerton University Hospital	Website	Homerton University Hospital. ACERS: Post COVID-19 patient information pack	https://www.hacknevcitizen.co.uk/wp-content/uploads/Post-COVID-19-information-pack-5.pdf	NHS developed patient information guide to support rehabilitation.
	NHS	Website	When Do I Need To Seek Help?	https://www.yourcovidrecovery.nhs.uk/your-road-to-recovery/when-do-i-need-to-seek-help/	UK developed public information resource. Recommends GP initial assessment then onwards referral to Post COVID clinics as appropriate (and available).
	Lancashire Teaching Hospitals NHS Foundation	Website	COVID-19: Supporting your recovery	https://covidpatientsupport.lthtr.nhs.uk/#/	UK developed patient information to support post-hospital discharge self-management and in-home recovery. Developed by a group of multi-disciplinary health professionals. Acute-recovery focused, minor mention Long COVID.
	Royal College of Occupational Therapists	Website	Post-COVID Syndrome (Long COVID)	https://www.rcot.co.uk/post-covid-syndrome-long-covid	UK developed resources primary aimed at occupational therapists and the public.
	Long COVID Physio	Website	Long COVID Physio Resources	https://longcovid.physio/resources https://longcovid.physio/rehabilitation https://longcovid.physio/exercise https://longcovid.physio/fatigue	International peer support physiotherapists, support workers and other AHP living with Long COVID. Website which pulls together professional resources and guidance on exercise, fatigue, post-exertional symptom exacerbation, pacing - physiotherapy focuses. Promotes stop, rest, pace principles.
	Physiopedia	Website	Long COVID	https://www.physio-pedia.com/Long_COVID	UK-based charity for physiotherapy-based resources. Links to online courses: 'Long COVID: what is it, how to manage, intervention, physical activity debate' and 'COVID-19 rehabilitation program'.
	World Physiotherapy	Website	Rehabilitation and Long COVID World PT day 2021	https://world.physio/sites/default/files/2021-06/WPTD2021-InfoSheet2-RehabandLongCOVID-Final-A4-v1a.pdf	Internationally developed for World Physiotherapy day 2021. General advice patient information poster for dissemination.
Fatigue	Royal College of Occupational Therapists	Website	How to conserve your energy: Practical advice for people during and after having COVID-19.	https://www.rcot.co.uk/conserving-energy	UK developed patient information guide to support self-management for energy conservation
	Chartered Society of Physiotherapy	Website	Covid-19: The road to recovery activity planner	https://www.csp.org.uk/system/files/documents/2020-06/001751_covid19-the_road_to_recovery_activity_planner_v3.pdf	UK developed activity planner to support self-management/awareness of symptoms. Also used by professionals to identify rehabilitation needs.
	Royal College of Occupational Therapists	Websites	How to manage post-viral fatigue after COVID-19. Practical advice for people who have been treated in hospital How to manage post-viral fatigue after COVID-19. Practical advice for people who have recovered at home	https://www.rcot.co.uk/how-manage-post-viral-fatigue-after-covid-19 https://www.rcot.co.uk/how-manage-post-viral-fatigue-after-covid-19-0	UK developed resources for patient information guides aimed at occupational therapists. Available publicly.
	Carter et al.	Website	An information booklet to help manage chronic fatigue brought on by Covid-19	https://www.shu.ac.uk/advanced-wellbeing-research-centre/projects/an-information-booklet-to-help-manage-chronic-fatigue-brought-on-by-covid-19	Electronic self-guide for fatigue post COVID. UK-based study in progress to determine feasibility of use.
Mental Health Support	Mental Health Foundation UK	Website	How to look after your mental health during the coronavirus outbreak.	https://www.mentalhealth.org.uk/coronavirus	Example of UK-based publicly available information to support mental health. NZ equivalent is https://mentalhealth.org.nz/getting-through-together
Ongoing Breathing Difficulties	Asthma UK and British Lung Foundation	Website	Post-COVID HUB	https://www.post-covid.org.uk/	UK-based post-COVID hub for public and professionals for ongoing breathing difficulties
	Asthma UK and British Lung Foundation	Website	Long COVID	https://www.blf.org.uk/support-for-you/long-covid	UK based public information hub about breathlessness support, movement and energy support, online modules, resources for at home and NHS pathways.
Nutritional Needs	Holdoway, A.	Commentary	Addressing nutrition in the road map of recovery for those with Long COVID-19	https://dx.doi.org/10.12968/bjcn.2021.26.5.218	Nutrition screening recommended. Links to UK malnutrition pathway and clinical resources (incl. dysphagia). Recommend tailored approach needed, may need onwards referral to dietician may be required.
	Malnutrition Pathway UK	Guideline	A Community Healthcare Professional Guide to the Nutritional Management of Patients During and After COVID-19 Illness	https://www.malnutritionpathway.co.uk/library/covid19_hcpguide.pdf	Guide developed for community health professionals. Malnutrition screening resources. Endorsed by the British Dietetic Association (BDA), the Royal College of Nursing (RCN) and the British Association of Parenteral and Enteral Nutrition (BAPEN)
	Malnutrition Pathway UK	Guideline	Managing Adult Malnutrition	https://www.malnutritionpathway.co.uk/covid19	UK based self-management advice. Overview with useful resources for patients and carers. Endorsed by the British Dietetic Association (BDA), the Royal College of Nursing (RCN) and the British Association of Parenteral and Enteral Nutrition (BAPEN)
Screening Questionnaires for Rehabilitation Needs	Sivan. M., et al.	Journal Article	Assessing long-term rehabilitation needs in COVID-19 survivors using a telephone screening tool (C19-YRS tool)	https://doi.org/10.47795/NELE5960	UK developed post-hospital discharge screening questionnaire (via phone) to identify potential rehabilitation needs, and potential MDT referral. Developed by PT, OT, SLT, psychology, dietetic and rehabilitation medicine specialists.
	Lemhöfer, C., et al	Journal Article	Assessment of rehabilitation needs in patients after COVID-19: Development of the COVID-19-rehabilitation needs survey	https://dx.doi.org/10.2340/16501977-2818	German developed COVID-19 Rehabilitation Needs Survey (C19-RehabNeS). MDT specialist developed. Assesses functional limitations and rehabilitation needs during and after infection, and satisfaction with the health services and treatment.
	O'Sullivan, O., et al.	Journal Article	Rehabilitation post-COVID-19: Cross-sectional observations using the Stanford Hall remote assessment tool	https://dx.doi.org/10.1136/bmjmilitary-2021-001856	UK military developed remote COVID-19 rehabilitation assessment tool. To allow timely triage, assessment and management. Tool developed by rehab medicine, OT, pain nurse, PT, exercise rehabilitation instructor. Tool also provides patient information and remote intervention pack

4. Thematic Analysis

A reflexive thematic analysis was completed on sources and key topics or themes identified. A theme was defined as the main topic or idea in the source relevant to the coping review objectives and inclusion criteria. All sources had a primary theme and for about half of sources a secondary theme was also identified (Table 4: Themes Identified.

Table 4: Themes Identified

Themes Identified	Primary theme	Secondary theme	Total included sources
Best Practice/Suggested Management	27	6	33
Rehabilitation tools	15	6	21
[Integrated] Care Pathway	14	6	20
Multidisciplinary	3	11	14
Model of Care	7	5	12
Technology & Tele-	4	3	7
Guideline	9	2	11
Other - Not further defined	2		2
Total	81	39	120

Discussion

Aotearoa New Zealand Context - prevalence data is currently unknown:

Currently the total number of confirmed cases and the acute illness burden is currently relatively low in New Zealand compared to the rest of the world (John Hopkins University Research Centre, 2021). Any rehabilitation recommendations should consider acute-phase survivors and those who arrive/return who may have had acute COVID infection overseas. With the eventual re-opening of the New Zealand borders and given recent community transmissions, the number of people with or who develop Long COVID in Aotearoa New Zealand is likely to increase. This necessitates the need to access appropriate diagnosis, support, management, and rehabilitation. At the time of writing, the 'New Zealand Covid Long haulers' Facebook group currently has 264 members, suggestive of possible prevalence. More accurate data on the prevalence and distribution of people Long COVID in New Zealand is essential to inform leaders and services about potential demands for services. The recently commissioned Victoria University study into the impacts of COVID-19 on people in Aotearoa New Zealand may examine this. This is relevant as internationally, the sources available about centres who developed post-covid clinics where large urban centres with high case numbers of acute-COVID.

Themes identified

The following is a discussion of the identified key themes from the thematic analysis identified, in order of the most common identified theme in this literature search.

Best Practice/Suggested Management

Sources tended to discuss approaches to exercise management and/or pulmonary rehabilitation, likely owing to that fatigue and shortness of breath are more common symptoms. This included discussion around safety considerations of exercise programs, such as use of as pacing and energy conservation to avoid worsening of symptoms. The role of the community and/or primary care-based management/advice is also explored and recommended. Such for initial diagnostic work-up (such as to rule out other health conditions) with appropriate primary or community-based management, and as part of a care pathway with onwards referral to an appropriate service or multidisciplinary team if indicated. Self-management strategies and resources were also identified as a valid and useful management strategy, which highlights that not all people with Long COVID may need to see a specialist but should be able to access reliable sources of information reflecting the current evidence base. Access to such resources should be explored for New Zealanders, this could be at a Ministry of Health level and/or at a regional or service level. Examples for overseas e.g., NHS provide an opportunity with a good base of information that would been to be tailored to Aotearoa New Zealand setting.

The psychosocial impacts of Long COVID are consistently highlighted as an area needing to be addressed and managed, especially as anxiety and depression is associated with the condition. No single resource was identified outlining specifics of management of this, rather it was a consistent

acknowledgment and emphasis on the need to be screening for mental health, good local pathways for referrals, links with any MDTs who may have appropriate health care professionals.

Possibly due to wide ranging symptoms and as this was an initial scoping review, no single source was identified with a clear consensus on 'best practice guideline' for clinical care. Literature often referred to clinical management being carried out in accordance with professional experience with Long COVID and/or drawing on similarities between other conditions, such as chronic fatigue syndrome or post-viral syndrome. Post-search completion new resources already exists that have been identified and potential references for best practice which have not been included in accordance with this methodology, the understanding of Long COVID continues to emerge. Such as the WHO 'Support for Rehabilitation Self-Management after COVID-19- Related Illness' Version 2. https://www.who.int/publications/m/item/support-for-rehabilitation-self-management-after-covid-19-related-illness - a toolkit for individuals to self-manage Long COVID. This demonstrates the rapidly evolving field for Long COVID and consequent limitations of this scoping review due to the selected time period data was sourced.

A next step could the development of a national technical advisory group. The make-up of this could reflect an appropriate multidisciplinary team who could pull on their professional expertise, networks, and grey literature sources such as professional body websites (nationally and internationally) to further develop the New Zealand knowledge base in this area. It is likely there are already professionals in New Zealand with this expertise to call on. A consumer lense with lived experience could be considered, there are examples of Long COVID advocacy groups initiated by health professions now with lived-experience of Long COVID.

Model of Care & Integrated Care Pathways/Care Pathways

(NB from this point in document sources not referenced)

Model of Care was initially a separate theme to Care/Integrated Care Pathways during data extraction. However, upon review of the sources and critical synthesis, these themes were merged for discussion purposes. Model of Care provides an overarching theme from the literature, where integrated care/care pathways can exemplify alternative or emerging model of care processes.

A phase-adapted model of care was proposed for acute, post-acute and chronic needs. Sources provided examples of models of care implemented e.g., University of North Carolina at Chapel Hill. Additionally, the WHO proposes a policy on a high-level model of care and what this should look like. Interestingly, one source argued that resources should not be relocated or added to a new service, rather existing solutions should be brought together. This was a single opinion piece, but raised a good question around how these models of care for the treatment/rehabilitation of Long COVID can be best delivered in an already constrained system, presumably within current resources? Any model of care needs to balance population needs but also ensure that people can access appropriate experts or professionals should this be needed. For example. In the UK there was specific funding allocated for post-COVID clinic development, this allowed clinics and pathways to be commissioned. Although beyond the scope of this review, in an Aotearoa New Zealand context resourcing will need

to be considered for the design, development and implementation of any new model or care or care pathways.

The potential need for a care pathway development was identified with a call for these to be integrated, international examples are available particularly for larger urban centres with high infection rates. There was emphasis on defining responsibility of care for the pathway, having abilities to onwards refer as appropriate, and knowing where/who to refer to (including to appropriate multidisciplinary teams that have been developed). Such care pathways should include post-hospital discharge follow-up in addition to a community referred pathway. Equity factors need to be considered in pathway development, although no data was identified on clinic outcomes of this aside from highlighting the need. Examples of care pathways and clinics are available e.g., Leeds Teaching Hospital post-COVID clinic, John Hopkin PACS etc. Pathways included community support, primary care and tertiary care, often taking a tiered approach depending on individual needs, and highlighted an approach to post-discharge follow up pathways such as the use of phone screening of potential needs. The pathways need to be appropriate to populations and regions and any pathways are likely to need infrastructure and administrative support.

The WHO also argues the need for such pathways and provides high-level advice about how these should be set-up. A national NHS guidance document for commissioning post-COVID syndrome clinics was also identified (possibly with funding associated to such clinics). There may need to be consideration and decision on what is the most appropriate approach to setting up a care pathway/s in the New Zealand context. Presumably this would need to factor in such things as the current disease burden, geographical considerations, funding, national or DHB level of response, all underpinned and driven by a focus on equity (including Māori and Pacific peoples, rurality, and other at-risk groups). At the time of writing this is highlighted by the recent Auckland community outbreaks where most people currently with acute-COVID are Pacifika people, a flag for a possible inequitable Long COVID population in future. An equity-based outcome approach must be considered in the development of any local or national pathways. Internationally, there are emerging concerns for inequitable outcomes as identified by John Hopkins post-COVID clinics; data is suggesting African Americans are over-represented in acute COVID presentations yet underrepresented in post-COVID clinic attendance. This has been flagged as concern warranting monitoring and follow-up to ensure equitable Long COVID outcomes for minority populations and the US context, for the under or un-insured. Aotearoa New Zealand has its own context, however a concerted focus on ensuring priority health populations including Māori and Pasifika and those at risk of barriers to healthcare access (e.g., rurality) can equitable outcomes is essential for any developed pathway.

National guidance on the development of clinics or care pathways could be developed, as a framework or guidance to support local and regional approaches. National NHS documents have been development as an example of this. The feasibility of pathway (local or national) development and implementation will need to be explored in the context of an already constrained health system undergoing transformational structural change; local needs should be factored in including

partnerships with communities and primary care so pathways are appropriate for the population they support.

Rehabilitation tools

Self-management patient guides and patient information were sourced (printed and online modules/material) to help with understanding their condition and to work through selected rehabilitation at home. Resources tended to be developed at a hospital level or regional level (i.e., NHS trust). The identification of these highlights a potential gap in New Zealand based resources for people to be able to access, this will need to be investigated.

Some profession-based management and pathways for post-COVID were identified e.g., UK malnutrition pathways, examples of specific exercise programs. The review was not able to investigate if these already exist New Zealand in the context of Long COVID so a next step would be completing a stocktake of any available New Zealand professional-based rehabilitation management tools for Long COVID, which would be achieved by approaching relevant professional bodies and/or performing website searches. Potential rehabilitation screening tools were also identified (e.g., C19-RehabNES, Stanford hall remote assessment tool etc); screening tool use could be considered if adapted to a New Zealand context. It would need to be determined whether any such screening forms are not already in use.

To note, some sources are yet to be charted from reference list scans which may uncover further tools. Additionally, this review was not able to search grey literature, including websites (aside from those referred in reference lists) so it is unlikely that the list of identified tools is exhaustive of all available.

Multidisciplinary

NICE and ISIGN guidelines support initial GP and community work-up and diagnosis with referrals onto appropriate MDTs (i.e., established integrated care pathways). Given that Long COVID is frequently heterogenous and complex, a clear theme was recognising the need for and establishing a mutli-professional team for such cases (via referral from GP or community provider), so that rehabilitation is tailored to an individual. Examples of multidisciplinary teams (MDT) included various medical and allied health professions such a Physiotherapists and Occupational Therapists, although it is important to note that specific MDT make-up differed between hospitals and services; examples also included Speech Language Therapy and/or Psychology involvement among others. This group may have had established links to a wider collaborative group (such as involving, but not limited to, cardiology and dietetics) as required. The teams should also have well-established good onwards referral processes and referral relationships to any other appropriate services beyond the core MDT, e.g., ENT, and these need to be varied due to the heterogenous nature of Long COVID. The Mayo Clinic, University of North Carolina at Chapel Hill COVID recovery clinic, and New York City's Mount Sinai Health System provide US examples of such MDTs, and there was UK-based examples also reported.

Sources shared that MDTs used existing knowledge about treating similar conditions, such as post-viral fatigue and professional expertise. The importance of regular case discussions and team

meetings as a MDT was highlighted as a factor for success, likely reflecting that Long COVID is a relatively new condition and there is an absence of developed best practice guidelines so sharing of knowledge and expertise was viewed as highly important for the overall care of the person.

This was the sole theme which was more commonly identified as a secondary theme. It is postulated that this reflects that a MDT approach already underpins most of the other themes. The importance of care pathway/s so MDT resource is optimised for complex cases truly requiring MDT input was also apparent.

Technology & Tele-

The use of technology and tele-health options emerged especially in the context of increased infection control protocols, social distancing requirements etc in a pandemic environment. Sources identified developed screening tools for rehabilitation needs e.g., C19-YRS tool which can be delivered over the phone as part of a care pathway post-acute phase. Technology could be used for remote pulse oximetry monitoring (e.g., John Hopkins PACT clinics) for monitoring of respiratory symptoms; literature around pulse oximetry monitoring appeared to be increasing suggesting an emerging important technology. Self-management tools such as online resources and modules could be utilised, there are numerous UK-developed examples (e.g., British Lung Foundation website).

The use of technology and tele- options is likely to be relevant in a New Zealand context, given currently comparable lower disease burden so could potential be used to span geographical inequities to allow access to specialist MDTs assessments. The practical details of this would need expert input. Underlying factors are that tele-options need to be accessible, including factor such people with hearing impairments and not disadvantage those who may not have access to internet/data or an electronic device.

As fatigue is common symptom of Long COVID, the utilisation of technology and tele-health options has been identified to potentially reduce the burden on patients. The utilisation of tele-based health options throughout the pathway such as at the GP or community-based assessment and weaving tele-health options also as of MDT assessment was identified; considering the energy burden on patients associated with attending potentially multiple healthcare professional assessments. An individualised approach tailored to the individual's symptoms, especially fatigue levels, was encouraged.

Guideline

Aside from the NICE and ISIGN guidelines, a Physiatrists guideline was identified, and one source argued a physiotherapy-lead clinic guideline. John Hopkins and University of California- San Francisco developed a 'how-to' guidelines for implementing post-covid clinics.

General considerations:

In the New Zealand context, these guidelines and available examples of existing post-covid clinics and care pathways will need to be reviewed by appropriate health planning and provider leaders to determine appropriateness for a New Zealand context. Any rehabilitation pathway needs to be

relevant to the New Zealand health system and meet the needs of the Aotearoa New Zealand Population, including our commitment to Te Tiriti O Waitangi.

Interestingly, there was only a small number of sourced referring to the needs of the paediatric population. This is an emerging space with a paucity of evidence identified and should be flagged for follow-up, despite global evidence mounting that children also suffer from Long COVID, and calls from the public to address this (e.g. Long COVID Kids social media and website). This reflects a risk that needs to be mitigated so children with Long COVID avoid under-diagnosis and are appropriately supported.

Emerging from the literature is a clear call for improved awareness about Long COVID from people who might have the condition and also healthcare professionals. Shared experiences from overseas described significant challenges navigating health systems to achieve a diagnosis and consequently appropriate support and rehabilitation. There is opportunity in New Zealand to proactively improve awareness of Long COVID as part of public health and health care professionals. Caution has also been given to Long COVID given it variable symptomology and presentation about appropriate work-up in primary care, the NICE and ISIGN guidelines provide further information on this. There may be a proportion of those with Long COVID who are able to be managed in the community or primary care with appropriate advice, guidance, and management (including self-managed). However as evidenced from overseas it is likely there will be people with more complex or burdensome Long COVID who may need to access specialist assessment and care – a pathway for this is likely to be important so that appropriate assessment and care can be sourced by those who need it, appropriate to presenting symptoms and impact on daily life. Symptom presentation is variable; in some cases, a specific professional may be appropriate e.g. as fatigue and shortness of breath is a common symptom, this may support physiotherapy or occupational therapy based approach, whereas complex symptoms are likely to require MDT assessment and intervention.

New Zealand Context

To consider:

- Current service considerations, constrained system undergoing transformative system change – how to deliver?
- Recommendations/next steps: expert panel likely needed with either with Long COVID experience (from overseas) or in NZ as expertise develops.
- Health care pathways: primary care and community care will need to collaborate with DHB/hospital level care (and vice versa)
- Needs to be relevant to our health system and meet the needs of the Aotearoa New Zealand Population, including commitment to Te Tiriti O Waitangi
- Need to build awareness: health care professionals, public – but balance with not inciting fear. Don't want 'over-testing' in constrained system.
- Complex problems needs complex/multifaceted solutions. Simple problems might need simple. Need tailored approach. Long COVID is heterogenous, although patterns and burden of this on the individual can vary. Need a point of contact/point of entry – this professional must understand that Long COVID is real (instead of "fobbed off"), needs to be aware what is available in terms of potential self-management, education resources, understanding they/the

patient might have to make sense of the situation. Then appropriate work-up (balancing current system constraints and over testing) whilst also needing to rule out any other conditions (chest X-ray as example). Would be good to get data on prevalence of multiple symptoms vs single.

- Examples of MDT clinics and integrated care pathways with tele supported screening and follow-up – for complicated cases. Need a tiered approach requiring different levels of input care – from self-management advice/guidance (relies in health care profession upskilling condition awareness) and education of the patient. Could show examples of pathways e.g. John Hopkins, Leeds, these are bigger urban centres. What is the geographical prevalence of Long COVID in NZ? How do we ensure equitable access to services? Tele- Systems need admins support, ?MDT clinic with tele option - do we need to look at a nationwide approach first then sharing of knowledge/expertise? MDT team meetings to share knowledge stated as important, yet could not identify specific treatment guidelines as yet. Relies on professional experience and experience with COVID, ie, practice-based evidence (as opposed to evidence-based practice)
- Suggest need specialist TAG to review specific treatments e.g. Pulmonary Rehabilitation, exercise physiotherapists. We may not have to do research here and likely more emerging data from overseas – but should be gathering NZ-based data and outcomes. How will this be developed given different DHB, referral pathways, systems and processes. Role for consumer lens with lived experience?
- Opportunity for NZ to create information resources e.g. similar to: https://www.yourcovidrecovery.nhs.uk/your-road-to-recovery/when-do-i-need-to-seek-help Which is a UK developed public information resource. Recommends GP initial assessment then onwards referral to Post COVID clinics as appropriate (and available)? Could be developed for NZ context

Terminology review

Given the emerging understanding of the condition, the Ministry of Health could review whether to continue using Long COVID terminology. There is some argument that Long COVID may not be appropriate as it may suggest ongoing active infection and the term itself was coined from those with the condition. Emerging terminology include post-COVID syndrome (to reflect the varying presentations) or more general terms such as ‘Post-COVID’ have emerged. Further discussion of this is beyond this review and should not preclude the update and development on guidance for rehabilitation.

Key Summary Points

Current and emerging evidence of best practice applied to Long COVID rehabilitation, within a multidisciplinary perspective has been identified across the literature.

Multidisciplinary or profession-based clinical guidance/resources and available clinical practice resources for Long COVID rehabilitation collated….

A reflexive thematic analysis of Long COVID rehabilitation identified the following key themes:

- best practice/suggested management
- model of care & integrated care pathways/care pathways
- rehabilitation tools
- multidisciplinary
- technology and tele- and

- Guideline

Limitations:

In terms of scoping review methodology, it is acknowledged this review utilised a single reviewer to chart the data, with escalation as appropriate. It is acknowledged that a scoping reviewed should have at least two reviewers (Peters, McInerney, Munn, Tricco, & Khalil, 2020; Tricco, et al., 2018)

Literature sources was from a selected fixed time period 9th July to 31st August 2021 only reflecting a fixed timeframe for the project. Due to the rapidly evolving and emerging nature of Long COVID and Long COVID rehabilitation, regular and periodic literature reviews and updates is recommended, and can be used to iteratively update and developed policies, procedures, or guidelines. The review can be viewed as current at the time of literature search only. The scoping review acknowledges NZ based information and resources is being rapidly developed or is already available. This initial scoping review sought to identify and analyse international research and literature and reflects and initial start point to support the update of Long COVID best practice in Aotearoa New Zealand. A review and understanding of Long COVID rehabilitation evidence already underway in New Zealand should follow.

Conclusions and implications for research and practice

- In the literature to date, it is identified further work needs to reflect that this is an emerging condition, no succinct phases to rehabilitation.
- In conclusion of this review, a range of international literature has identified a number of key themes, implications for research and a practice expert advisory group to continue to take these findings forward to develop best practice guidance.
- The University of Wellington is funded for study into impacts of COVID-19 on people in Aotearoa New Zealand, it will need to be identified if some of the research questions will be looking at Long COVID
- There is an opportunity for local data to be prospectively collated and linked to outcomes of individuals reporting long COVID symptoms.

Funding

This review was funded by the Ministry of Health Chief Allied Health Professions Office.

References

Barker-Davies, R., O'Sullivan, O., Senaratne, K., Baker, P., Cranley, M., Dharm-Datta, S., . . . Bahadur, S. (2020). The Stanford Hall consensus statement for post-COVID-19 rehabilitation. *British Journal of Sports Medicine*(54), 949-959. doi:10.1136/bjsports-2020-102596

Dani, M., Dirksen, A., Taraborrelli, P., Torocastro, M., Panagopoulos, D., Sutton, R., & Lim, P. (2021, January). Autonomic dysfunction in 'Long COVID': rationale, physiology and management strategies. *Clinical Medicine, 21*(1), e63-67. doi:10.7861/clinmed.2020-0896

Daynes, E., Gerlis, C., Chaplin, E., Gardiner, N., & Singh, S. (2021). Early experiences of rehabilitation for individuals post-COVID to improve fatigue, breathlessness exercise capacity and cognition - A cohort study. *Chronic Respiratory Disease, 18*, 1-4. doi:10.1177/14799731211015691

de Sire, A., Andrenelli, E., Negrini, F., Patrini, M., Lazzarini, S., & Ceravalo, M. (2021, April). Rehabilitation and COVID-19: a rapid living systematic review by Cochrane Rehabilitation Field updated as of December 31st, 2020 and synthesis of the scientific literature of 2020. *European Journal of Physical and Rehabilitation Medicine, 57*(2), 181-188. doi:0.23736/S1973-9087.21.06870-2

Greenhalgh, T., Knight, M., A'Court, C., Buxton, M., & Husain, L. (2020, August). Management of post-acute covid-19 in primary care. *British Medical Journal (Clinical research ed.), 370*, m3026. doi:10.1136/bmj.m3026

John Hopkins University Research Centre. (2021, August 26). *Coronavirus Research Centre*. Retrieved August 26, 2021, from Mortality Analyses: https://coronavirus.jhu.edu/data/mortality

Ministry of Health. (2020). *Guidance for the rehabilitation of people recover from COVID-19 in Aotearoa New Zealand.* Retrieved from https://www.health.govt.nz/publication/guidance-rehabilitation-people-or-recovering-covid-19-aotearoa-new-zealand

NHS. (n.d.). *When do I need to seek help?* Retrieved August 11, 2021, from NHS Your COVID Recivery: https://www.yourcovidrecovery.nhs.uk/your-road-to-recovery/when-do-i-need-to-seek-help/

NICE. (2020, December 18). *COVID-19 rapid guideline: managing the long-term effects of COVID-19.* Retrieved from National Institute for Health and Care Excellence : www.nice.org.uk/guidance/ng188

Nurek, M., Rayner, C., Freyer, A., Taylor, S., Järte, L., MacDermott, N., & Delaney, B. (2021). Recommendations for the recognition, diagnosis, and management of Long COVID: a Delphi study. *British Journal of General Practice*. doi:10.3399/BJGP.2021.0265

Peters, M. D., McInerney, P., Munn, Z., Tricco, A. C., & Khalil, H. (2020). Chapter 11: Scoping Reviews. In E. Aromataris, & Z. Munn (Eds.), *JBI Manual for Evidence Synthesis* (pp. 407-452). doi:https://doi.org/10.46658/JBIMES-20-01

Santhosh, L., Block, B., Kim S, Raju, S., Shah, R., Thakur, N., . . . Parker, A. (2021). Rapid Design and Implementation of Post-COVID-19 Clinics. *Chest, 160*(2), 671-677. Retrieved from https://doi.org/10.1016/j.chest.2021.03.044

Shah, W., Hillman, T., Playford, E., & Hishmeh, L. (2021). Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline. *British Medical Journal (Clinical Research ed.), 372*(n136), 1-4. doi:10.1136/bmj.n136

SIGN. (2020). *SIGN 161 Managing the long-term effects of COVID-19: National guidance for identification, assessment and management.* Scottish Intercollegiate Guidelines Network, Edinburgh. Retrieved from https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., . . . Straus, S. (2018, October). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine, 167*(7), 467-473. doi:doi:10.7326/M18-0850

Vanichkachorn, G., Newcomb, R., Cowl, C., Murad, M., Breeher, L., Miller, S., . . . Higgins, S. (2021). Post-COVID-19 Syndrome (Long Haul Syndrome): Description of a Multidisciplinary Clinic at Mayo Clinic and Characteristics of the Inital Patient Cohort. *Mayo Clinic proceedings, 96*(7), 1782-1791. Retrieved from https://doi.org/10.1016/j.mayocp.2021.04.024

WHO. (2021, October 6). *A clinical case definition of post COVID-19 condition by a Delphi consensus, 6 October 2021.* Retrieved October 9, 2021, from World Health Organization: https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1

WHO. (2021). *Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID.* World Health Organisation. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf

Appendix A: Commonly reported symptoms of Long COVID (WHO, Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID, 2021; SIGN, 2020).

<table>
<tr><td>Respiratory
Breathlessness
Cough</td><td>Generalised
Fatigue[2]
Fever
Pain</td><td rowspan="2">Neurological
Cognitive impairment (‘brain fog’, loss of concentration or memory issues)
Headache
Sleep disturbance
Peripheral neuropathy symptoms (pins and needles and numbness)
Dizziness
Delirium (in older populations)</td></tr>
<tr><td>Cardiovascular
Chest tightness
Chest pain
Palpitations</td><td>Gastrointestinal
Abdominal pain
Nausea
Diarrhoea
Anorexia and reduced appetite (in older populations)</td></tr>
<tr><td>Musculoskeletal
Joint pain
Muscle pain</td><td rowspan="2">Ear, nose and throat
Tinnitus
Earache
Sore throat
Dizziness
Loss of taste and/or smell</td><td>Dermatological
Skin rashes
Pressure sores</td></tr>
<tr><td>Psychological/psychiatric
Symptoms of depression
Symptoms of anxiety</td><td></td></tr>
</table>

[2] Fatigue is the most commonly reported enduring symptom

Appendix B: Search Strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions(R) <1946 to July 09, 2021>
Search Strategy:

---

1 (2019-ncov or ncov19 or ncov-19 or 2019-novel CoV or sars-cov2 or sars-cov-2 or sarscov2 or sarscov-2 or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or coronavirus-19 or covid19 or covid-19 or covid 2019 or ((novel or new or nouveau) adj2 (CoV on nCoV or covid or coronavirus* or corona virus or Pandemi*2)) or ((covid or covid19 or covid-19) and pandemic*2) or (coronavirus* and pneumonia)).mp.
2 limit 1 to (english language and yr="2020 -Current")
3 (long adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
4 (long adj3 haul*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
5 (post* adj covid* adj3 syndrome*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
6 (chronic adj covid* adj3 syndrome*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
7 (("long term effect*" or "long-term effect") adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
8 (prolong* adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
9 (lasting adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10 (lingering adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
11 ((post discharge or post-discharge) adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
12 ((post acute or post-acute) adj3 covid*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
13 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
14 2 and 13
15 rehab*.mp.
16 exp rehabilitation/
17 manag*.mp.

18 ((mental health or psychosocial or psycho-social) adj3 support*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
19 multidisciplinary or therapy or therapies or integrated or multi-disciplinary
20 ((physical or occupational or speech or diet*) adj3 therap*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
21 (respiratory adj3 therap*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
22 15 or 16 or 17 or 18 or 19 or 20 or 21
23 14 and 22

****

Appendix C: Data Characteristics Extracted via Data Charting Tool

Characteristics extracted	Definition
Full source record number	Numeric Value. Source number if full source list. Full source list included all sources that were identified in the Librarian database search and reference list scanning. This includes all sources regardless of inclusion, if excluded a brief rationale was noted in 'comments'.
Search Source	Categorical: Ministry health Librarian database Search, Reference List Scanning of Ministry health Librarian database Search.
Author/s	Source author.
Publication Date	Source publication date
Source/Evidence Type	Source evidence type categories developed *a priori* and included: Abstract, Book, Book Section, Journal Article, Journal - Ahead of print, Journal Article - In-process, Journal Article - In-data-review, Journal - other non-indexed citation, Online Media/News Paper, Online Document, Website, Commentary, Letter to the Editor, Guideline, Editorial
Country of Origin	Country of origin of source
Title	Source title
URL	Source URL
Topic/s	Free-type field. Researchers' interpretation of topic/s of course, often determine by keyword or abstract.
Participant Details	Free-type field. Where applicable for research-based sources (e.g., age/sex. Number). For guidance or guideline documents, expert panel membership make-up recorded.
Methodology	Free-type field. Study or source development methodology summarises (where applicable)
Context	Free-type field. As relevant, comments on context of source. May include geographical location, service-type/location (primary care, community, long-term care, etc.), relevant perspective of source. Relevant cultural, social, ethnic, or gender factors.
Findings/Outcomes Extracted	Free-type field. Key finding related to scoping review extracted – researcher's interpretations.
Limitations	Free-type field. Any limitation/s of the source (source self-identified or research-identified) as relevant to scoping review interpretation.
Areas for future research	Free-type field. Potential areas of future research (source self-identified or research-identified) as relevant to scoping review interpretation.
Primary Theme*	Defined as the main topic or idea in the source relevant to the coping review objectives and inclusion criteria. Primary theme categories included: Best Practice/Suggested Management, Multidisciplinary, Rehabilitation tools, Technology & Tele-, [Integrated] Care Pathway, Model of Care, Guideline, Other - not further defined
Secondary There*	Defined as the secondary topic or idea in the source relevant to the coping review objectives and inclusion criteria, for sources where a secondary theme was identified. Secondary theme categories included: Best Practice/Suggested Management, Multidisciplinary, Rehabilitation tools, Technology & Tele-, [Integrated] Care Pathway, Model of Care, Guideline, Other - not further defined
Argument/Perspective	Free-type field. Overall argument/perspective of source surmised by researcher as relevant to the source (e.g., column not completed for any identified patient information sources).
Page number/key quote/findings related to review questions	Free-type field. Relevant page numbers, tables or figure numbers, relevant to review.

* *a priori* understanding of the emerging evidence for Long COVID rehabilitation suggested some likely themes would emerge (e.g., Best practice, Multidisciplinary, Rehabilitation tools, Technology), however a reflexive and iterative approach was used as new evidence emerged, the newly identified themes were updated.

Document 2

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

This form contains the details relevant to the questions posed to the Science and Technical Advisory (STA). STA will respond to the request using this form which will also be stored in STA content management system for future reference.

This form, or parts of it, may also be forwarded to other relevant parties as appropriate.

Title	Long COVID Information for Care in the Community		
Subject	Long COVID prevalence and impacts		
Reference No.	390	Date Received	13/01/2022
Requestor	Tiffany Vail, Senior Advisor, Health System Preparedness Programme (on behalf of COVID Care in the Community team)	Date Due	Click or tap to enter a date.
Advisor	Sarah Mitchell, Senior Advisor	Date Completed	22/02/2022
Peer reviewed by	Pippa Scott, Principal Advisor and Brooke Hollingshead, Senior Advisor		
Advice issued to	Tiffany Vail, Senior Advisor, Health System Preparedness Programme		
Approved by	Dan Bernal, Manager		
Deliverables	• Definition and features of long COVID • Information about the prevalence and impact of long COVID in various countries • Outline of New Zealand-based research and resources on long COVID • Other useful long COVID resources		
Request Outline	**Background/Context** The COVID Care in the Community team have been thinking about 'Long COVID' and how it will impact on health system funding and resources. They recently secured funding for primary care and community organisations to support COVID-19 positive people while isolating in community settings and need to establish a position on how care for people with Long COVID fits in to this, if at all. **Questions** We were wondering if your team had done any work on, or were aware of any research/articles/literature reviews etc, relating to the prevalence and impacts of Long COVID in NZ or comparable overseas countries? **Intended application of advice** To inform consideration of how to best support patients with Long COVID in the community.		

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH
MANATŪ HAUORA

What are the implications and considerations of this advice on Te Tiriti o Waitangi and equity?	COVID-19 has disproportionately affected vulnerable populations and exacerbated existing inequities, and the burden of long COVID is likely to continue this trend.[1] In New Zealand, Māori and Pacific Peoples make up an increasing proportion of COVID-19 cases, so it is possible that long COVID may have a particularly high burden in these populations who already face a range of challenges. They may also face additional barriers seeking or accessing treatment for long COVID or financial barriers to affording treatment. For some people, long COVID results in being unable to work for an extended period of time. Support options for these situations need to be considered. In addition, long COVID is a complex condition that may not be adequately understood or recognised by the medical profession, creating further difficulties for patients seeking validation of their experience and support, worsening existing access and equity issues.

Contents

Response to Request for Advice

It is important to note that long COVID would occur outside of the isolation period for new COVID-19 cases. People with long COVID can be severely impacted for a significant period of time and establishing mechanisms to support them is important.

Definition/ Features of long COVID

Although most people with COVID-19 recover and return to normal health, some people can have symptoms that last for weeks or months after 'recovery' from the acute illness.[2] Throughout the pandemic, various terminology and definitions have been to describe the ongoing health impacts of COVID-19. The term 'Long COVID' has been commonly used, particularly by patient groups. Other terms include post-acute COVID-19, persistent COVID-19 symptoms, ongoing COVID-19, long-term sequalae, long-haulers, and post-acute sequelae of SARS-CoV-2 infection (among others).[3] The Centers for Disease Control and Prevention (CDC) notes that [4]: *"Post-COVID conditions are a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19. Even people who did not have COVID-19 symptoms in the days or weeks after they were infected can have post-COVID conditions. These conditions can present as different types and combinations of health problems for different*

lengths of time." Although long-term impacts are more commonly reported in patients who had severe or critical disease, such effects can also occur in people who had a mild experience of the infection.[3]

Research on long COVID and management of patients with long COVID has been hampered by the absence of both a single terminology and a clinical case definition.[5] In order to advance the recognition and care of persons experiencing ongoing health impacts, in October 2021 the World Health Organization (WHO) proposed a clinical case definition for 'post COVID-19 condition'[5]:

> *"Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others which generally have an impact on everyday functioning. Symptoms may be new onset, following initial recovery from an acute COVID-19 episode, or persist from the initial illness. Symptoms may also fluctuate or relapse over time. A separate definition may be applicable for children."*

Long COVID can involve multiple organs and can affect many systems of the body, including (but not limited to) the respiratory, cardiovascular, neurological, gastrointestinal, and musculoskeletal systems.[6] Some common symptoms of long COVID include fatigue, dyspnoea, cardiac abnormalities, cognitive impairment, sleep disturbances, symptoms of post-traumatic stress disorder, muscle pain, concentration problems, and headache.[6] A systematic review and meta-analysis published in August 2021 found that the five most common symptoms were fatigue (58%), headache (44%), attention disorder (27%), hair loss (25%), and dyspnoea (shortness of breath) (24%).[3]

Global prevalence

According to the WHO, "*the burden of post COVID-19 health issues is not very well documented. Yet, preliminary results from a nationally representative sample survey by the UK Office for National Statistics estimate that around **1 in 10 respondents** who tested positive for COVID-19 may exhibit symptoms for a period of 12 weeks or longer. Other studies in the USA and Switzerland indicate that around **a third of people** who tested positive for SARS-CoV-2 had not returned to their usual state of health when interviewed 3 to 6 weeks after diagnosis. Another recent study in the USA found that **30% of COVID-19 patients** surveyed still had persistent symptoms after nine months. The majority of patients surveyed (85%) were outpatients with mild illness. Another recent study in the USA found that **30% of COVID-19 patients** surveyed still had persistent symptoms after nine months. The majority of patients surveyed (85%) were outpatients with mild illness."* [2]

The systematic review and meta-analysis published in August 2021 estimated that the number of people with SARS-CoV-2 who developed one or more long-term symptoms could be as high as 80% of patients.[3] Another systematic review, published in October 2021, included 57 studies comprising more than 250,000 survivors of COVID-19.[7] The mean age was 54.4 years, and 79% were hospitalised during acute COVID-19. High-income countries contributed 79% of the studies. The median (IQR) proportion of COVID-19 survivors experiencing at least 1 post-acute sequelae of COVID-19 (PASC) was 54.0% (45.0%-69.0%; 13 studies) at 1 month (short-term), 55.0% (34.8%-65.5%; 38 studies) at 2 to 5 months (intermediate-term), and 54.0% (31.0%-67.0%; 9 studies) at 6 or more months (long-term). That is, more than half of COVID-19 survivors experienced PASC 6 months after recovery. The authors conclude that these long-term PASC effects occur

on a scale that *"could overwhelm existing health care capacity, particularly in low- and middle-income countries."*[7]

However, the prevalence of long COVID is difficult to establish for a range of reasons, including[3, 8, 9]:

- Studies of long COVID have used different measurement criteria and different inclusion criteria, so they cannot be reliably compared. Studies also often differ in the way they collect data.
- Studies have focused on different groups of people, different symptoms, and time intervals, and used different sample sizes.
- Most studies report the frequency of at least one symptom (not necessarily the same symptom), rather than a cluster of symptoms.
- Published studies may not be representative of everyone who has long COVID.
- Difficulties in accessing COVID-19 testing in different countries may mask the true number of long COVID cases if studies require testing confirmation of the initial infection. In addition, testing policies vary between countries.
- The ways in which responses are elicited can impact estimated prevalence (e.g., app users are self-selected and responsible for recording symptoms, which can result in sampling and recording biases). In addition, many studies use retrospective self-reported symptoms.
- Some tools validated for other diseases may not be appropriate for use in long COVID patients.
- The prevalence of long COVID may also vary greatly depending on the groups studied (for example, app users vs population studies vs studies of patients who were hospitalised [8]).

New Zealand-based research and resources on long COVID

This section lists research from New Zealand sources (not necessarily about New Zealand) which may be helpful. To date, there is little information on the prevalence, incidence, and management of long COVID within Aotearoa New Zealand.

- The Insights and Reporting Team in the DPMC's COVID-19 Group have analysed the impact overseas of post COVID-19 health related conditions, known collectively as Long COVID, and how this impacts the workforce and wider society. The report includes a definition of Long COVID, its prevalence, its impact on workforces and social welfare implications, government responses to it internationally, and its economic impact overseas. Countries analysed include the United Kingdom, Spain, Sweden, Ireland, and the United States. This is being shared with the Care in the Community team with permission from DPMC, but noting the IN-CONFIDENCE classification. The final version of this document will be sent in a separate email.
- A longitudinal study of the impact of COVID-19 on people in Aotearoa New Zealand funded by the Ministry of Health was announced last year (media release here) and will soon be beginning recruitment. Victoria University of Wellington have been granted $1.2 million for the project, which will be conducted over a period of approximately 12 months. The overarching objective of the longitudinal study is to improve our understanding of the immediate and long-term physical, psychological, and economic impacts of COVID-19 on people in Aotearoa New Zealand. The study will involve surveys as well as interviews with subgroups of the cohort. There will be a particular focus on key subgroups including Māori, Pacific people, people with disabilities (including **long COVID**), and people who developed COVID-19 through their employment. This study will include

those with laboratory confirmed or probable COVID-19. One of the key outcomes for the longitudinal study is to contribute to research on the long-term impacts of COVID-19, using both quantitative surveys (that align with international research projects) and qualitative interviews. This includes profiling those with long-term post-viral fatigue syndrome.

- The Ministry of Health has a webpage about long COVID here (however, note that the webpage is due for an update by the Science and Technical Advisory (STA) team).
- In 2021 STA wrote a Science Brief about Long COVID (here). The aim of this document was to review current information and guidance on the epidemiology, diagnosis and management of long COVID. This evidence brief was intended to inform an update of a document that was published by the Ministry of Health in June 2020, entitled *'Guidance for the rehabilitation of people with or recovering from COVID-19 in Aotearoa New Zealand'*. Dr Martin Chadwick (Chief Allied Health Professions Officer) would be the key contact for information about this work.
- The National Institute for Health Innovation (NIHI) has been collating information about Long COVID for patients and health professionals (here).
- Researchers at the University of Auckland and University of Otago are currently looking for people to participate in a study to investigate immune and molecular markers following recovery from COVID-19 (including post-Covid condition/long COVID) and following COVID-19 vaccination in adult volunteers (link). These studies will aim to investigate immune dysregulation and long-term immunity in those with long COVID, while also investigating the relationship of long COVID to other post-viral conditions, for example Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome (ME/CFS).
- Health Navigator also has an information page about long COVID (link).
- There are active community-led support and advocacy groups. For example, the 'New Zealand Covid Long Haulers' Facebook group for people in New Zealand with long COVID had 331 members as of 17 January 2022. This is likely to represent only a portion of people in New Zealand with long COVID. They aim to improve recognition, research, and rehabilitation for people with long COVID.
- There is also a LongCOVIDNZ Twitter page.

Further resources - Impacts of long COVID

Other general comments and useful resources include:

- See Martin et al (2021) for a discussion of potential long COVID impacts, including on health and care services, societal and economic impacts[5]: The objective of this paper is to model lost Quality Adjusted Life Years (QALYs) from symptoms arising from COVID-19 disease in the UK population, including symptoms of 'long-COVID'. The scope includes QALYs lost to symptoms, but not deaths, due to acute COVID-19 and long-COVID. *"Based on the current parameterisation, 557,764 QALYs would be lost over 10-years, 286,454 to permanent injury as a result of COVID-19 and 271,310 from symptoms of COVID-19 across all timescales. This corresponds to an average loss of 0.013 QALY per infection. An estimated 90,142 people could be left living with significant impairments as a result of injury from COVID-19."*
- In the wake of the pandemic: preparing for Long COVID (2021)[10] (2021 Policy Brief by WHO)
- Living with Covid19 – Second review [11] (National Institute for Health Research, March 2021)

- Long COVID: The long-term health effects of COVID-19 [12] – Rapid response on UK Parliament website, December 2021
- Covid 19 Delta outbreak: Concern long COVID will soon burden health system (NZ Herald Nov 2021)
- As of July 2021, "long COVID," also known as post-COVID conditions, can be considered a disability under the Americans with Disabilities Act (ADA).[4] Multi-disciplinary teams are crucial to developing preventive measures, rehabilitation techniques, and clinical management strategies with holistic and whole-patient perspectives designed to address long COVID-19 care.[3]

References

1. Beasley, R., N. Kearns, and T. Hills, *Charting a course for the management of long COVID.* The Lancet Respiratory Medicine, 2021. **9**(12): p. 1358-1360.
2. World Health Organisation (WHO). *Post COVID-19 condition (Long COVID).* 2021 16 October 2021 [cited 2022 17 Jan]; Available from: https://www.who.int/srilanka/news/detail/16-10-2021-post-covid-19-condition.
3. Lopez-Leon, S., et al., *More than 50 long-term effects of COVID-19: a systematic review and meta-analysis.* Scientific Reports, 2021. **11**(1): p. 16144.
4. Centres for Disease Control and Prevention. *Post-COVID Conditions*. 2021 16 September 2021 [cited 17 January 2022]; Available from: https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Flong-term-effects.html.
5. World Health Organisation (WHO). *A clinical case definition of post COVID-19 condition by a Delphi consensus*. 2021 6 October 2021; Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1.
6. Crook, H., et al., *Long covid—mechanisms, risk factors, and management.* BMJ, 2021. **374**: p. n1648.
7. Groff, D., et al., *Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review.* JAMA Network Open, 2021. **4**(10): p. e2128568-e2128568.
8. Martin, C., et al., *A model framework for projecting the prevalence and impact of Long-COVID in the UK.* PloS one, 2021. **16**(12): p. e0260843-e0260843.
9. Ministry of Health, N.Z. *Long COVID*. 2021 21 June 2021 [cited 2021 17 January]; Available from: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.
10. World Health Organization (WHO). *Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID*. 2021; Available from: https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf.
11. National Institute for Health Research *Living with Covid19 – Second review*. 2021.
12. Vagnoni, C. *Rapid response - Long COVID: The long-term health effects of COVID-19*. 2021 17 December 2021 [cited 2021 17 January]; Available from: https://post.parliament.uk/long-covid-the-long-term-health-effects-of-covid-19/.

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

Next Steps	If required, a deeper dive on these topics could be prepared.
In the development of this work, the following parties have been consulted with:	DPMC

Resources used:		
Ministry of Health Policies and Procedures	☒ Yes ☐ No	
External Health Scientific organisations	☒ Yes ☐ No	
Existing database of RFAs	☒ Yes ☐ No	
Internal Ministry of Health Advice	☐ Yes ☒ No	
External Expert Advice	☒ Yes ☐ No	Long COVID report from the Insights and Reporting Team in the DPMC's COVID-19 Group
Literature Review	☒ Yes ☐ No	Quick review, including previous work by the STA team

Long COVID Services Report for Northern Region
Draft v2 (January 2022)
Felicity Oh, i3 Summer Student

Summary of public Long COVID services overseas

The overall aim of Long COVID (LC) services is to provide an integrated, multidisciplinary approached service with seamless treatment pathways that ensure personalised LC recovery plans for people with LC. The UK is a leading country for LC initiatives as seen with their set up of 90 long COVID assessment clinics to date (1) - several regional UK services are described more in depth as potential exemplar services (on pages 6-7). The UK system relies heavily on GP services to carry out the initial assessments, as is the case for other countries (2-6), where family doctors and primary care physicians are the first point of contact for most LC patients in the community.

The core clinicians involved in the multidisciplinary teams (MDTs) of LC services are mainly respiratory physicians, nurses, physiotherapists (PT), occupational therapists (OT), sports therapists, psychologists, speech and language therapists, dietitians, and social workers (2,4,7-8). However, other services offer further specialist support from cardiologists, ENTs, infectious diseases specialists, neurologists, pulmonologists, nephrologists, rheumatologists, sleep medicine specialists, psychiatrists, and immunologists (2,4,7-10).

The general process for existing LC services involves an initial assessment/evaluation done in person, at home or office via telemedicine, and following treatment plans are designed based on one's specific ongoing symptoms. The clinical leader for each service differs depending on the setting. For example, an internal medicine specialist at a US post-COVID clinic spends an hour with each new patient (10) whilst a UK service has specialist physiotherapists and occupational therapists who are responsible in conducting an initial 45-60 minute telephone assessment (11). Other services refer to whole day assessments or same day diagnostics (10,12). Several LC services involve virtual clinics which refer patients directly to the appropriate services/specialists (13-14). MDT discussions play a crucial part in the co-ordination of care.

This scoping review found that most services can be divided into three groups depending on setting; in primary care services, hospital-based services, and rehabilitation management focussed services. Due to the range of severity there are a range of services i.e. home support can be managed by GP/nurse-led services whilst more complicated cases require appropriate specialist input. Some services have utilised existing infrastructure, others have created new facilities, or a combination of both, and this can be observed within countries as well based on different local resources (5, 15). However, it is important to note that differences in the set-up of LC clinics in the UK has created significant unwarranted variation in access and level of assessment provided (16).

Primary care based services: In the UK, GP practices are able to sign up to a NHS Enhanced service specification.pdf (17). This requires education of staff about the condition, development of pathways for self-management i.e., referral to a social prescriber or health and wellbeing coach, and local clinical pathways for signposting or referring into appropriate pathways. This includes:

1. Your COVID Recovery website
2. Post COVID Assessment Clinics
3. Other local rehabilitation or support services**.**

Long COVID Triage and Assessment Services ensure patients are referred onto the right clinical pathway to support their ongoing rehabilitation and recovery, and GPs can refer people, if appropriate, to the service (18) (see appendix 4 for patient info pack). Practices are entitled to payments per registered patient upon sign up to the Enhanced Service and monitoring via monthly instalments (17).

Another example of a primary care based service is a service set by One Health Lewisham GP Provider in the UK that has input from secondary care as required through a GP Extended access service located in a hospital (19). By having a more specialist team within primary care, the MDT is able to provide a holistic assessment/screening as well as management of symptoms (19).

Hospital based services: Many public university hospitals have set up specialised post-COVID care centres/clinics to serve their local regions in countries such as Czechia (2), Canada (6,20-21), Italy, Brazil (2), Switzerland (3), Austria (4), US (22), and UK (12,23). Specialised LC outpatient assessment clinics are often set up as part of the cardiac or respiratory outpatient clinics. These services generally have the resources and speciality to become a one-stop shop service. For example, a US university hospital provides mental health support specialised for post COVID-19 as well as social workers and pharmacists alongside the main MDT (22). Research embedded services (research assistants within the clinics) also exist where patients can participate in LC studies in countries such as Austria, US, and Canada (4,6,22).

Rehabilitation and management focussed services (see pages 6-10): Several LC services in Canada and Scotland are led by allied health, and a few regional National Health Service (UK NHS) Trusts involve a dedicated team of allied health professionals who provide single but, coordinated treatment plans.

Eligibility criteria: Eligibility for services varies from 4 weeks to 12 weeks of ongoing symptoms after the start of confirmed or suspected acute COVID-19 infection, but most require >12 weeks since initial diagnoses. Most services emphasise that patients do not need evidence of positive COVID tests as long as GP/physician referrals are provided whilst there are also few services that allow self-referral (19,23).

Some services have specified inclusion criteria e.g. one MDT referral source (24) mentions requiring one of the following:

- New onset AND unexplained shortness of breath since presumed infection
- New onset AND unexplained cough since presumed infection
- New onset AND unexplained musculoskeletal or organ pain since presumed infection
- New onset AND unexplained fatigue since presumed infection
- New onset AND unexplained neurological symptoms since presumed infection
- New onset psychological or mental health issues occurring in relation to presumed infection

Measures: The Post COVID-19 Functional Status (PCFS) and COVID-19 Yorkshire Rehab Screen (C19-YRS) (see appendix 3) are two main tools LC services are currently utilising (25-26). The PCFS is an ordinal tool that measures the full spectrum of functional outcomes following COVID-19 and can be used for tracking functional status over time. PCFS grade ranges from 0 (no functional limitations) to 4 (severe functional limitations) (see page 21). PCFS was found to be used by Canadian services according to the CDC guideline and the Alberta service is an example of how the PCFS scale is used in combination with their symptom checklist for LC rehabilitation triage processes (see page 16). C19-YRS consists of 22 items with each item rated on a numerical rating scale from 0 (none of the symptom) to 10 (extremely severe level/impact) (see page 22).

Various LC services were also found to have their own screening questionnaires using yes/no questions, worse/same/better measures, or ordinal scales for common LC symptoms. For example, pre-assessment questionnaires (27) or baseline questionnaires (28), and the Newcastle Post-COVID Syndrome Follow-up Screening Questionnaire identifying patients who may benefit from a comprehensive face to face multi-disciplinary assessment if symptoms persist for 10 to 12 weeks after the acute illness (29). Despite different time points, the types of questions services use are relatively similar and can be represented by a validated Patient Long COVID Symptom tool (30) with its inclusion of general symptoms, neurological, thorax, musculoskeletal, digestive, ENT, skin and hair, eyes, vessels and ganglia, urinary and genital categories.

Most sources mention the use of already existing outcome measures such as but not limited to:

- Quality of life measures: EuroQol-5D (EQ-5D) (8,31-33), SF-36 questionnaire (32,34-35)
- Fatigue measures: Fatigue Severity Scale (FFS) (8,31-33), 11-item Chalder Fatigue Questionnaire (8)
- Exercise capacity measures: 30 second sit-stand test (32), 6 min walk test (31,34,36)
- Patient-Reported Outcomes Measures: PROMIS scales (8,31,33-34)

A Therapy Outcome Measure (TOM) scale for patients with Long COVID is in development by the Royal College of Speech and Language Therapists through the recognition for improved COVID-19 rehabilitation services (37-38). The TOM Impairment Scale is an ordinal scale ranging from 0 to 5 with specific descriptors for each LC related impairment (e.g. cardiac impairment, swallowing impairment, chronic fatigue). The scale also allows half points to indicate whether a patient slightly better or worse than a descriptor. In addition, a core outcome set (COS) for Post-COVID Condition/Long COVID is being developed by international experts together with WHO, ISARIC (International Severe Acute Respiratory and emerging Infection Consortium), and patient partners for both clinical and research use. The project aims to complete the first phase (what outcomes to measure) in the summer of 2021 and the second phase (how to measure these outcomes) in 2022) (39). Tiers of COS may be considered (e.g. Tier 1 – general and Tier 2 - subspecialised to assess system-specific consequences of COVID-19) (40).

Overall, most services were found to use similar screening/outcome measures (see appendix 3) and mention how completion of questionnaires at baseline, 8 weeks or 3 months and 6 months can be used as an outcome measure (8,32,41).

Services for indigenous groups/different ethnic populations: There are currently no reports of services specifically designed for indigenous groups although CDC (33) and NHS (8) guidelines state that minority ethnic groups and underserved or vulnerable groups should be prioritised. They also recommend LC services provide interpreters, advocates, and other support to minimise barriers to access.

Note: For the purposes of this report, information on Long COVID services for children and young people (CYP) have been excluded.

Guidelines

The recommendations provided by several Long COVID guidelines can be useful for the decision-making process of setting up an appropriate LC service. A summary of the advice provided by each guideline is described below:

NICE/SIGN/RCGP joint guideline – COVID-19 rapid guideline: managing the long-term effects of COVID-19 (7)

This guideline is split into 11 sections (excluding sections on "how to use this guideline" and "methods and evidence reviews"):

- **Identification**: Provides clinical case definition to identify and diagnose LC. Applies for people who have had suspected/confirmed acute COVID-19, irrespective of whether they were hospitalised or had a positive/negative COVID test.
- **Assessment:** Include a comprehensive clinical history and appropriate examination that involves assessing physical, cognitive, psychological and psychiatric symptoms, as well as functional abilities.
- **Investigations and referral:** Offer blood tests, chest radiograph (if appropriate), exercise tolerance tests, blood pressure, heart rate recordings to help rule out acute or life-threatening complications and alternative diagnoses.
- **Planning care:** Should be individualised, patient-led and use shared decision making.
- **Management (self-management and supported self-management, multidisciplinary rehabilitation, additional support):** Advice on who to contact, how to get support from other services e.g., social care, housing, employment and financial support. Consider supported self-monitoring at home such as heart rate, blood pressure, pulse oximetry or symptom diaries (tracking app to record progress towards personal goals and recovery)
- **Follow up, monitoring and discharge:** Through shared decision making, offer people option of in person or remote monitoring.
- **Sharing information and continuity of care:** Sharing clinical records and plans for care and rehabilitation between services and through MDT meeting.
- **Service organisation:** Providing access to multidisciplinary services ('one-stop' clinics) should be led by a doctor with relevant skills and experience and appropriate specialist support. The core team should at least include occupational therapy, physiotherapy, clinical psychology, and psychiatry and rehabilitation medicine. Referral pathways need to be integrated and well organised to prevent disjointed/fragmented care.
- **Common symptoms:** Covers respiratory, cardiovascular, generalised symptoms, neurological, gastrointestinal, musculoskeletal, ENT, dermatological, and psychological/psychiatric symptoms.
- **Recommendations for research**: Interventions for LC and prevalence of LC.
- **Equality considerations**: Age, disability, gender reassignment, race, sex, socioeconomic factors, and digital accessibility.

LC services were found to mention the NICE guidelines when referring to how LC is identified (12) and use as recommended resources for health professionals (Canada) (42). Countries such as Italy and Canada were found reproducing the guidelines or aligning with it (4,6). Most UK services (12-

13,24,32,43) were found to be similar in their set up and appeared to follow the general recommendations of the NICE guidelines and NHS National guidance for post-COVID syndrome assessment clinics guideline.

NHS National guidance for post-COVID syndrome assessment clinics (8)

This guideline describes the three main referral routes into post-COVID assessment services. Two routes are "people hospitalised with COVID-19" and "people cared for in an Intensive Care Unit or High Dependency Unit with COVID-19". The other pathway for "people never admitted to hospital with their acute illness but managed independently or in the community" is relevant for the many people reporting long COVID symptoms that will have not been admitted to hospital during the acute phase of their infection. It notes that initial assessments should be carried out by the GP and if investigations/support are required, the patient may be referred into a post-COVID assessment service.

The three principles of care for Long COVID are stated as:

1. Personalised care
2. Multidisciplinary support and rehabilitation
3. Supporting and enabling self-care.

The section on service design states that services may be located on a single site or delivered across multiple sites, or virtually. Accessibility in terms of geographical location and delivery model should be prioritised with an opportunity for patients to have a multidisciplinary assessment plus diagnostics, at least for the initial physical assessment. Psychosocial and cognitive issues may be addressed at the same time or subsequently, and potentially utilise digital platforms.

The section of the guidelines on workforce describes the disciplines involved in creating personalised plans for LC patients as well as their role in the MDT, for example, how district/community nursing can support both the patient and wider family needs whilst also supporting coordination of services.

Survivor Corps Guideline (36)

The post-COVID care guideline for multidisciplinary care centres firstly refers to a basic list of necessary infrastructure for Post-COVID Care Centres (PCCC) (see appendix 1). It notes how patients should be able to self-refer to the clinic if Primary Care Physician referrals are unavailable, and self-care information should be provided especially if appointments are scheduled greater than 2 weeks out. The ideal initial intake consists of a virtual visit for patient assessment, enrolment into an online portal to upload any prior relevant diagnostic test results and a scheduled in person appointment with a member of the PCCC team (infectious disease doctor or internal medicine doctor) who will act as the Treatment Ambassador and the patient's liaison with other specialized medical providers. Once the standard set of tests are run (see appendix 1) and evaluated by the Treatment Ambassador, they will put together a team of 3-4 appropriate providers based on patients worst lingering symptoms and work together to come up with a personalised treatment plan. This team will refer the patient to other providers, as needed, in addition to the care they provide, and have team meetings with the patient either in person or virtually (as needed) to discuss and monitor progress ideally once every 2 weeks. The guide also notes that immunology tests should be available at the centre. However, it is important to note that Survivor Corps is a patient advocacy organisation and no examples of the guideline used in practice were found.

CDC Guideline (33)

The U.S. Centers for Disease Control and Prevention (CDC) guideline is an interim guidance last updated on June 14, 2021. There is limited information in comparison to the previous guidelines but a section on assessment and testing tools is provided (see appendix 1). The guidelines also report how follow-up visits with a healthcare professional might be considered every 2–3 months and when material, employment or other social support needs are identified, they should consider referral to a social worker, case worker, community health worker to assist.

Rehabilitation Guidelines

The Royal College of Occupational Therapists guidelines (44) focusses on providing practical advice for people during and after COVID-19. The guide is helpful for teaching people to Pace, Plan and Prioritise (the 3 Ps principle) daily activities to help post-COVID patients to save energy (See appendix 1). Similarly, there are other practical guides for and Rehabilitation for allied health professionals such as the Clients with Post COVID-19 Condition (Long COVID) Guidance for Canadian Rehabilitation and Exercise Professionals (45), and Rehabilitation and Allied Health Practice Considerations Post COVID-19 Report (46) (see appendix 4). Rehabilitation guidelines were found to be available on LC service websites as useful resources for both patients and providers (42-43).

Exemplar Long COVID Services

NHS Foundation Trust Long COVID Services:

All services involve a baseline assessment of LC symptoms generally via telephone and involve a single point of access service. For example, in Suffolk and North East Essex, the Care Coordination Centre (CCC) acts as a single point of contact for patients who have been referred to the LC Assessment Services. CCC staff arrange an initial telephone assessment and manage onward referrals for the additional support patients need, closely working with MDTs (47). Although some patients will require more than one other service, a strong Integrated Care System ensures access to a wide variety of services which allow a dedicated team of allied health professionals provide single, coordinated treatment plans (13). Patients are tracked to ensure they are receiving the appropriate care and followed up at 12 and 26 weeks to check whether they can be discharged (47).

In comparison, Trafford LC Service single point of access is with a GP and involves a triage nurse to conduct the initial one-hour telephone assessment (questionnaire must be completed prior to the call) (14). The Vale of York and North Yorkshire management and referral guidance also mentions that patients are required to have been sent and self-completed the C19-YRS screen (24). Trafford's tier 3 MDT (see page 15) develops a care plan and face-to-face appointment happens at a patient's local site with signposting/referral for community rehabilitation service or specialist physiotherapists (i.e. respiratory, neurology) help via the normal pathway. On the other hand, another regional NHS service was found to involve a Community LC Single Point of Access service to provide a virtual or face-to-face clinic-based assessment of needs. The service is only available for LC patients who have not responded to initial self-care measures (43). This service also works closely with Vita Health Group who can provide short term psychological therapies and the North Bristol Trust's Bristol Chronic Fatigue Syndrome/Myalgic Encephalomyelitis Service. Most NHS services state that only GP referrals are currently accepted (14,24,47,48).

Royal Berkshire is another NHS Foundation Trust that partnered with an Integrated Care Partnership to set up their Berkshire LC Integrated Service (49). Although the service is provided by a MDT, it

highlights that the service is mainly focussed on assessment and subsequent signposting to available community resources (49). Another example is the University College London Hospitals post-COVID follow up service (12) which partners closely with their region's LC community services, holding regular MDTs as well as involving psychology services. The Imperial College Health Partners were found to have worked with acute, community and primary care providers to launch three specialist assessment clinics and six administrative based community MDTs to manage post-COVID patient caseloads for North West London (50). The Health Partners emphasise the importance of establishing key relationships between the specialist assessment clinics and the community MDTs. MDTs require the ability to consult with wider consultant expertise (e.g. cardiology, neurology) where needed (24).

The North East London Foundation Trust also mentions how their LC service includes community based rehabilitation service which offers access to extra support such as finances (48). Importance of a formal Peer Support Group such as virtual group consultations and specific support groups for ethnic minority/communities were also emphasised (8,14). Furthermore, several NHS services mentioned the involvement of anonymised patient data collection for the National Institute for Health Research (13).

Scotland Long COVID Service:

The Scotland LC service based on four key elements (51):

1. Supported self-management

- Building capacity to self-manage via telephone consultations for a period of up to 12 weeks (dependent on individual needs) Link to action plan: https://www.chss.org.uk/documents/2021/09/long-covid-action-plan.pdf
- Chest Heart and Stroke Scotland (charity) funded to deliver 'Long COVID Support Service' mainly in the form of an advice line to speak Nurses and Allied Health Professionals trained in managing some of the most common symptoms of LC (e.g., breathlessness, fatigue, pacing, anxiety). Aims to work with GPs and develop support plan for people early on in their LC experience whilst they await further treatment (52).

2. Primary care and community-based support

- Assessment by local primary care team and advice on third sector services.
- Further support from primary care, community and mental health services, including rehabilitation, and referral to secondary care settings where necessary.
- Existence of SIGN Decision Support platform which provides healthcare professionals with an integrated point of access to evidence-based information on supporting people with long COVID.

3. Rehabilitation support

- Assessment of abilities by rehabilitation therapist and subsequent rehabilitation plan based on patient's goals which is aimed to be delivered within a primary care setting as much as possible. When referral to specialist services is required, this should be done through the care co-ordinator.
- Based on a national survey (15), one regional service mentioned providing energy conservation advice and assessment of aids and adaptations whilst another service provided fatigue management, confidence building, muscle strengthening, anxiety management, nutritional advice, breathing re-education, and activities to support individuals to regain

function. Another service used a combination of pulmonary rehabilitation and community reablement.

- Community rehabilitation service provision for people with Long COVID is multidisciplinary. Almost all services include occupational therapy and physiotherapy. Many include dietetics and speech and language therapy. Half include psychology input.
- Three services reported being able to refer to, or having the involvement of differing resources including post intensive treatment nursing teams, therapy assistant practitioners, outpatient services for people with neurological conditions, spiritual care teams, and specialist rehabilitation medical consultant services.
- Other routes of access to LC rehabilitation including interdisciplinary referrals from other allied health professionals and social care, as well as referrals from informal carers (15).

4. Secondary care investigation and support

- Patient may be referred to different specialities, or for more than one type of investigation, depending on their needs. One role of the care co-ordinator is to support this process and act as a central point of contact for the patient during this process. Both the patient and care co-ordinator will be informed of results and planned follow-up care.

Alberta Long COVID Service:

In Alberta, community accessible Post-COVID-19 rehabilitation service provides assessment and treatments for eligible LC patients and includes one-on-one interventions, education, self-management strategies, interpreter/translation services and connection with other community resources (41-53). However, patients must be able to attend an outpatient clinic (three service locations in total).

Adopting the C19-YRS tool and PCFS, three levels of rehabilitation care are recommended (54).

- PCFS Grade 0 to 1 (mild functional impairment): Consider **universal** rehabilitation interventions (self-management resources)
- PCFS Grade 2 to 3 (moderate functional impairment): Consider **targeted** rehabilitation interventions – directed to the needs of a group of individuals with common needs/issues and is intended to enhance group capacity by creating supportive and structured environments e.g. coaching/consultation, group experience programs.
- PCFS Grade 3 or 4 (severe functional impairment): Consider **personalized** rehabilitation interventions – MDT required for treatment care plan

Rehabilitation Advice Line created by Alberta Health Services is also available for LC patients to help triage, assess, and provide recommendations (54). The Rehab Advice line is answered by Allied Health clinicians and will provide referral letters back to caller/patient's primary care provider (55).

Free online post-COVID zoom classes were added to their already existing Healthy Living Program. There are five different virtual workshops available for LC; Eating after COVID-19, Managing Breathing and Sleep, Managing Daily Life, Managing Pain & Getting Active, Managing Stress (56). Resources for health professionals are also available (42) (see appendix 4).

Summary

In conclusion, the main components and key considerations found necessary for the setup of a successful LC service from this report are listed below.

Key components needed in LC services:

- Education of patients, whānau, and health professionals regarding LC is essential and up-to-date LC information must be provided through respected sources (e.g. public website).
- Referrals: Services should accept referrals from existing health services (e.g. primary care, hospital services) as well as self-referrals to minimise access barriers.
- An initial assessment: There should be a standard initial assessment process that can be conducted as much as possible remotely (questionnaires, telehealth etc) by allied health or nursing professionals. This will identify areas of specific concern for further investigation and patient needs in terms of ongoing services and support. Agreed LC criteria would help with providing a diagnosis.
- Self-management support: An easily accessible support place for LC related queries, resources, and concerns should be available whether this is in the form of an advice line or online support tool or information hub.
- MDT: A dedicated MDT should be responsible for developing care plans for individuals with LC following initial assessment and referring patients to specialist services or community services where needed.
- Patient/peer support groups: Mechanisms for enabling people to support each other, and share information has been appreciated by international groups.
- Service delivery: Prioritising remote methods (e.g. telehealth and remote monitoring) for patient assessments and follow-ups and MDT meetings, and follow up services is beneficial.
- Measures: Agreed measures should be adopted to determine patient progress, discharge criteria, and for evaluation of the effectiveness of the LC service.

Key considerations for developing our LC service:

- Clear communication between health professionals at all levels of care (primary care, community care, hospital/specialist care) particularly in the context of referral pathways for the LC service to be strongly coordinated.
- Maintaining a patient and whānau-centred approach for LC service delivery is critical for understanding the needs of individuals with LC and achieving such integrated coordination of care.
- As little is known about the experience of LC in Māori and Pacific proactive engagement with Māori and Pacific communities is needed to ensure experiences of LC (including those differing from international guidelines) are accommodated by the LC service and that support and treatment is prioritised.
- Multidisciplinary input and engagement are essential, not just within the medical system but across social and community services.
- Acknowledging the limited evidence for LC treatment options, ongoing research is important to understand LC better and improve LC services. Research embedded within services will be beneficial for understanding patient experience, provider experience, and enabling data collection (e.g. prevalence, demographics) which is especially important for investigating how Māori and Pacific populations are impacted by LC.

- Ongoing active collaboration with international LC services is crucial to maintain the highest standard of care as the COVID-19 pandemic progresses.
- Flexibility in being able to adapt to the changing context of COVID, LC and increasing understanding of how the NZ population is responding to LC is paramount. Preparation for scale-up/down and involvement of other existing services such as mental health support service and social services as needed.

References

1. People with long Covid facing months-long wait for treatment at specialist NHS clinics. Inews [Internet]. 2021 Nov 22 [cited 2021 Dec 7]. Available from: https://inews.co.uk/news/nhs-figures-reveal-a-huge-shortfall-in-long-covid-treatment-1310377
2. European Observatory on Health Systems and Policies, Rajan, Selina, Khunti, Kamlesh, Alwan, Nisreen, Steves, Claire. et al. (2021). In the wake of the pandemic: preparing for long COVID. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/339629
3. Raaflaub C. What have we learned about long Covid?. Swissinfo.ch [Internet]. 2021 Aug [cited 2021 Dec 7]. Available from: https://www.swissinfo.ch/eng/what-have-we-learned-about-long-covid-/46888538
4. Wolf S and Erdös J. Long COVID care pathways: a systematic review. AIHTA. 2021. Wien: HTA Austria – Austrian Institute for Health Technology Assessment GmbH.
5. Cacaeres V. How Do Post-COVID Care Clinics Help Long COVID Patients? U.S News & World Report [Internet]. 2021 Oct 26 [cited 2021 Dec 7] Available from: https://health.usnews.com/conditions/coronavirus-and-your-health/articles/post-covid-care-clinics
6. Decary S, Dugas M, Stefan T, Langlois L, Skidmore B, Bhéreur A, and LeBlanc A. Care Models for Long COVID – A Living Systematic Review. First Update – December 2021. SPOR Evidence Alliance, COVID-END Network. Available from: https://sporevidencealliance.ca/wp-content/uploads/2021/12/Care-Models-for-Long-COVID_Update_2021.12.04.pdf
7. National Institute for Health and Care Excellence, Scottish Intercollegiate Guidelines Network, and Royal College of General Practitioners. COVID-19 rapid guideline: managing the long-term effects of COVID-19 [Internet]. UK: NICE; 2020 [updated 2021 Nov 11; cited 2021 Dec 7]. (NICE guideline [NG188]). Available from: https://www.nice.org.uk/guidance/ng188
8. NHS England and NHS Improvement. National Guidance for post-COVID syndrome assessment clinics. UK: NHS; 2020 [updated 2021 Apr 26; cited 2021 Dec 7]. Available from: https://www.england.nhs.uk/coronavirus/publication/national-guidance-for-post-covid-syndrome-assessment-clinics/
9. Leichman AK. Long Covid – the lengthy road ahead [Internet]. Israel21c: Abigail K Leichman; 2021 May 11 [cited 2021 Dec 7]. Available from: https://www.israel21c.org/the-lengthy-road-ahead-of-us-with-long-covid/
10. Cacaeres V. How Do Post-COVID Care Clinics Help Long COVID Patients? U.S News & World Report [Internet]. 2021 Oct 26 [cited 2021 Dec 7] Available from: https://health.usnews.com/conditions/coronavirus-and-your-health/articles/post-covid-care-clinics
11. Healthwatch Nottingham & Nottinghamshire. Health and Social Care Needs of People with Long COVID. 2021 Aug. Available from: https://wiltshirehealthandcare.nhs.uk/service/bsw-long-covid-rehabilitation-assessment-clinic/

12. University College London Hospitals NHS Foundation Trust. Post-COVID follow-up service [Internet]. London (UK): UCLH NHS Foundation Trust; 2021 [cited 2021 Dec 12]. Available from: https://www.uclh.nhs.uk/our-services/find-service/covid19-clinics/post-covid-followupservice
13. NHS North East Essex CCG. NEW CARE PACKAGE FOR LONG COVID PATIENTS LAUNCHED IN SUFFOLK AND NORTH EAST ESSEX [Internet]. UK: NHS North East Essex Clinical Commissioning Group; 2020 [cited 2021 Dec 10]. Available from: https://www.neessexccg.nhs.uk/new-care-package-for-long-covid-patients-launched-in-suffolk-and-north-east-essex
14. Trafford Clinical Commissioning Group. Trafford Post-Acute COVID Assessment Guide for Primary Care ADULTS. UK: Trafford CCG. 2021 Mar. Available from: https://www.traffordccg.nhs.uk/docs/Publications/Policy-and-Procedure/Post-Acute-COVID-19-GP-assessment-pathway-ADULT-VERSION.docx
15. Duncan E, Cooper K, Cowie J et al. A national survey of community rehabilitation service provision for people with long Covid in Scotland [version 2; peer review: 2 approved]. F1000Research [Internet]. 2021 [cited 2021 Dec 11]; 9:1416. Available from: https://doi.org/10.12688/f1000research.27894.2
16. Lovett S. 'Only a fraction' of long Covid sufferers able to access NHS support clinics [Internet]. 2021 Sep [cited 2021 Dec 18] Available from: https://www.independent.co.uk/news/health/long-covid-nhs-clinic-support-treatment-b1917924.html
17. NHS. Enhanced service specification Long COVID 2021/22 [Internet]. UK: NHS; 2021 [cited 2021 Dec 7]. Publications approval reference: C1313. Available from: https://www.england.nhs.uk/publication/enhanced-service-specification-long-covid-2021-22/
18. NHS Hull Clinical Commissioning Group. Humber Long COVID Triage and Assessment Service [Internet]. UK: NHS Hull Clinical Commissioning Group; 2021 [cited 2021 Dec 7]. Available from: https://www.hullccg.nhs.uk/humber-long-covid/
19. One Health Lewisham. Cold Hub [Internet]. London (UK): One Health Lewisham; 2021 [cited 2021 Dec 8] Available from: https://onehealthlewisham.co.uk/ohl-clinical-services-cold-hubs/
20. Ireland N. A year into pandemic, long-haul COVID-19 sufferers still struggle to get care. CBC News [Internet]. 2021 Apr 1 [cited 2021 Dec 9]. Available from: https://www.cbc.ca/news/canada/toronto/long-haul-covid-19-care-1.5970257
21. Scarborough Health Network. Long COVID-19 Service [Internet]. Canada: Scarborough Health Network; [cited 2022 Jan 12]. Available from: https://www.shn.ca/long-covid-19-service/
22. University of California, Los Angeles Health. Long Haul COVID [Internet]. California, LA: UCLA Health; 2021 [cited 2021 Dec 7]. Available from: https://www.uclahealth.org/medical-services/long-covid
23. Healthwatch Nottingham & Nottinghamshire. Health and Social Care Needs of People with Long COVID. 2021 Aug. Available from: https://www.healthwatch.co.uk/sites/healthwatch.co.uk/files/reports-library/20210907_Nottinghamshire_Long-Covid-Report-FINAL.pdf
24. Vale of York NHS. Long Covid (>12 week post-Covid) Management and Referral Guidance. UK: Vale of York Available from: https://www.valeofyorkccg.nhs.uk/seecmsfile/?id=5160&inline=1
25. Klok FA, Boon GJAM, Barco S, Endres M, Geelhoed JJM, Knauss S et al. Post COVID-19 Functional Status (PCFS) Scale: a tool to measure functional status over time after COVID-19. Eur Respir J. 2020 July; 56(1) 2001494. Available from: https://erj.ersjournals.com/content/56/1/2001494

26. Sivan M, Halpin SJ, Gee J. Assessing long-term rehabilitation needs in COVID-19 survivors using a telephone screening tool (C19-YRS tool). Adv Clin Neurosci Rehabil 2020; 19: 14-17. Available from: https://doi.org/10.47795/NELE5960
27. North & East Devon Formulary and Referral. Long COVID pre-assessment questionnaire. Available from: https://northeast.devonformularyguidance.nhs.uk/documents/Referral-documents/Long-Covid-Pre-Assessment-Questionnaire-v3.docx
28. Provincial Health Services Authority. POST COVID-19 RECOVERY CLINIC BASELINE QUESTIONNAIRE. British Columbia (Canada): Provincial Health Services Authority; 2021 [cited Dec 18]. Available from: post_covid-19_recovery_clinic_baseline_questionnaire.pdf
29. NHS. Newcastle Post-COVID Syndrome Follow-up Screening Questionnaire. Available from: https://www.rdash.nhs.uk/wp-content/uploads/2021/03/Newcastle-Post-Covid-Screening-Questionnaire.pdf
30. Tran VT, Riveros C, Clepier B, Desvarieux M, Collet C, Yordanov Y, Ravaud P. Development and validation of the long covid symptom and impact tools, a set of patient-reported instruments constructed from patients' lived experience. Clin Infect Dis [Internet]. 2021 Apr [cited 2021 Dec 16]: ciab352. Available from: https://doi.org/10.1093/cid/ciab352
31. Management of Post-COVID Conditions - Evaluating and Caring for Patients with Post-COVID Conditions: Interim Guidance. (CDC) Updated June 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-management.html
32. Parkin A, Davison J, Tarrant R, Ross D, Halpin S, Simms A et al. A Multidisciplinary NHS COVID-19 Service to Manage Post-COVID-19 Syndrome in the Community. J Prim Care Community Health. 2021 Jan-Dec;12:21501327211010994. Available from: https://pubmed.ncbi.nlm.nih.gov/33880955/
33. Centers for Disease Control and Prevention. Management of Post-COVID Conditions - Evaluating and Caring for Patients with Post-COVID Conditions: Interim Guidance. U.S: CDC; 2021 [updated Jun 2021; cited 2021 Dec]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-management.html
34. The Welsh Government. REHABILITATION: Post Covid-19 Evaluation Framework. Available from: https://gov.wales/sites/default/files/publications/2020-07/rehabilitation-post-covid-19-evaluation-guidance_0.pdf
35. Lemhöfer, C., Sturm, C., Loudovici-Krug, D. *et al.* The impact of Post-COVID-Syndrome on functioning – results from a community survey in patients after mild and moderate SARS-CoV-2-infections in Germany. J Occup Med Toxicol. 2021;16(45). Available from: https://doi.org/10.1186/s12995-021-00337-9
36. Survivor Corps. Post-COVID Care: Guidelines for Multidisciplinary Care Centers. 2021 [updated 2021 Mar 22; cited 2021 Dec 2]. Available from: https://www.survivorcorps.com/pccc
37. Enderby P, John A. RCSLT Online Outcome Tool Therapy Outcome Measures [Internet]. UK: Royal College of Speech and Language Therapists; 2022 [cited 2022 Jan 5]. Available from: https://www.rcslt-root.org/
38. Enderby P, John A. Long COVID Rehabilitation Services Therapy Outcome Measure-- Draft Adapted Scale. Available from: TOM Long Covid-- draft 9 pdf.pdf
39. International Severe Acute Respiratory and emerging Infection Consortium. Researchers start new investigation into Long COVID core outcome set [Internet]. 2021 Aug 11 [cited 2021 Dec 21]. Available from: https://isaric.org/researchers-start-new-investigation-into-long-covid-core-outcome-set/
40. Comet Initiative. Core Outcome Measures for Post-Covid condition/Long Covid [Internet]. 2021 [cited 2021 Dec 21]. Available from: https://cometinitiative.org/Studies/Details/1847

41. Neurosciences, Rehabilitation & Vision Strategic Clinical Network. Post COVID-19 Rehabilitation Response Framework Summary Report. Alberta (Canada): Alberta Health Services; 2021 [cited 2022 Dec 6]. Available from: https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-post-covid-rehab-response-framework-summary.pdf
42. Alberta Health Services. Recovery & Rehabilitation After COVID-19: Resources for Health Professionals [Internet]. Alberta (Canada): Alberta Health Services; 2021 [updated 2021 Nov 18; cited 2022 Jan 5]. Available from: https://www.albertahealthservices.ca/topics/Page17540.aspx
43. NHS Bristol, North Somerset and South Gloucestershire CCG. Long COVID (after 12 weeks) [Internet]. UK: NHS BNSSG CCG; 2021 [cited 2021 Dec 17]. Available from: https://remedy.bnssgccg.nhs.uk/covid-19/long-covid-after-12-weeks/
44. Royal College of Occupational Therapists. How to conserve your energy. London (UK): Royal College of Occupational Therapists. Available from: https://www.rcot.co.uk/conserving-energy
45. The Interdisciplinary Long COVID Advisory Panel. Clients with Post COVID-19 Condition (Long COVID) Guidance for Canadian Rehabilitation and Exercise Professionals. 2021 Sep. Available from: https://physiotherapy.ca/sites/default/files/site_images/Advocacy/long_covid_en-final-rev2.pdf
46. Albera Health Services. Rehabilitation & Allied Health Practice Considerations Post COVID-19. Alberta (Canada): Alberta Health Services; 2021 [revised 2021 Nov 1; cited 2021 Dec 7]. Available from: https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-rehab-allied-health-practice-considerations-post-covid.pdf
47. NHS North East Essex Clinical Commissioning Group (CCG). COORDINATING CARE FOR PATIENTS WITH LONG COVID-19 [Internet]. UK: NHS North East Essex CCG; 2021 [cited 2021 Dec 16]. Available from: https://www.neessexccg.nhs.uk/coordinating-care-for-patients-with-long-covid-19
48. NELFT NHS Foundation Trust. Long Covid: Rehabilitation services for local patients [Internet]. London (UK): NELFT NHS Foundation Trust; 2021 [cited 2021 Dec 17]. Available from: https://www.nelft.nhs.uk/information-and-advice-on-long-covid
49. Royal Berkshire NHS Foundation Trust. Long COVID [Internet]. UK: Royal Berkshire NHS Foundation Trust; 2021 [cited 2021 Dec 17] Available from: https://www.royalberkshire.nhs.uk/our-services/long-covid/
50. Imperial College Health Partners. Supporting patients recovering from the long-term effects of COVID-19 [Internet]. London (UK): Imperial College Health Partners; 2021 [cited 2021 Dec 11]. Available from: https://imperialcollegehealthpartners.com/portfolio/post-covid-syndrome-support/
51. Scottish Government. Scotland's Long COVID Service [Internet]. Scotland: The Scottish Government; September 2021 [cited 2021 Dec 8]. ISBN: 978-1-80201-355-9. Available from: https://www.gov.scot/publications/scotlands-long-covid-service/documents/
52. Godden S, McCool M. Thousands 'not referred' to long Covid support service. BBC [Internet]. 2021 Sep 2 [cited 2021 Dec 12]. Available from: https://www.bbc.com/news/uk-scotland-58409187
53. Neurosciences, Rehabilitation & Vision Strategic Clinical Network. Post COVID-19 Rehabilitation Response Framework Summary Report. Alberta (Canada): Alberta Health Services; 2021 [cited 2022 Dec 6]. Available from: https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-post-covid-rehab-response-framework-summary.pdf
54. CTV News Edmonton. COVID-19 long haulers in need of support making treatment plans, insurance claims. CTV News Edmonton [Internet]. 2022 Jan 5 [cited 2022 Jan 5]. Available

from: https://edmonton.ctvnews.ca/covid-19-long-haulers-in-need-of-support-making-treatment-plans-insurance-claims-1.5726878

55. Alberta Health Services. AHS Community Adult Post-COVID/Long COVID Patient Supports (Edmonton Zone) [Internet]. Alberta (Canada): Alberta Health Services; 2021 [cited 2022 Jan 5]. Available from: https://www.pcnconnectmd.com/wp-content/uploads/2021/09/Memo-AHS-Community-Post-COVID-Supports_2021AUG27.pdf
56. Alberta Health Services. Alberta Healthy Living Program Improving your health and quality of life to those with a chronic condition [Internet]. Alberta (Canada): Alberta Health Services; 2021 [cited 2022 Jan 5]. Available from: https://www.albertahealthservices.ca/info/page13984.aspx

Appendix 1 – Guidelines

Survivor Corps

Post-COVID Care Guideline for Multidisciplinary Care Centers.pdf (Command Line)

Evaluation & Diagnostic Health Assessment

At first Screening in-person visit, a complete evaluation and set of tests should be run (note: the specific tests are not listed).

- ❑ Blood tests
- ❑ Antibody and/or T-cell assessment
- ❑ Assessment if cardiac function
- ❑ Assessment of lung function
- ❑ Assessment of ears, nose and throat
- ❑ Assessment of neurological function (scan and MOCA-blind cognitive assessment)
- ❑ Assessment of vascular function
- ❑ Bowel and urine tests
- ❑ Assessment by Physical Therapist/ Occupational Therapist (ie 6 minute walk test)
- ❑ Measurement of oxygen levels
- ❑ Assessment of eyesight
- ❑ Assessment of skin rashes and hair loss
- ❑ Medication reconciliation
- ❑ Pain assessment
- ❑ Nutritional assessment
- ❑ Cognitive and emotional assessments
- ❑ Assessment of mental health (depression, anxiety, PTSD, sleep, appetite)
- ❑ Sleep testing
- ❑ Assessment of social/lifestyle (including housing, food and employment security)

NHS

National guidance for post-COVID syndrome assessment clinics.pdf (Command Line)

Royal College of Occupational Therapists

[Post-viral fatigue - Practical advice for people who have recovered at home (1).pdf]

How to manage post-viral fatigue after COVID-19
Practical advice for people who have recovered at home

Allow time
COVID-19 affects people differently, so give yourself time to recover. Its impact afterwards doesn't always reflect the severity of the virus and you don't have to have been hospitalised to experience fatigue. You may feel pressure to resume your usual activities quickly, but **don't rush**.

Have fun
Do some low energy activities that you enjoy, such as reading or watching TV, for short periods with regular rests.

Stop work
Please follow government guidelines. Unless you feel fully recovered after self-isolation, you shouldn't work. Your body still needs to focus on fighting the infection.

Next steps

Try activities
If you still feel fatigued after self-isolation but overall, you're improving, keep being gentle with yourself. Slowly try a small amount of light activity that is manageable (probably less than you think) with regular rests. Be mindful that you may feel more tired the next day. Be realistic and kind to yourself.

Rest
Your body still needs rest to continue healing, so take short breaks throughout the day, even if you don't think you need to. Stop and do nothing, calm your mind, and try breathing or guided relaxation techniques.

Daily routine
Routine helps your body to stabilise itself. Slowly resume your routine for sleeping, eating and daily activities. If this isn't possible, create a realistic one to follow for now and gradually adjust back to your normal routine. Remember, **don't rush**. If you're having difficulty sleeping, check out the tips and advice from NHS Every Mind Matters.

'Thinking' activities
Continue to limit everyday 'thinking' activities, such as emails, planning shopping, making decisions, as these all use energy. Try to do them only for set times with regular rest in between.

rcot.co.uk | intensive care society 50 YEARS proud to be the voice of critical care since 1970 | Royal College of Occupational Therapists

How to manage post-viral fatigue after COVID-19: Practical advice for people who have recovered at home (May 2020)

How to manage post-viral fatigue after COVID-19
Practical advice for people who have recovered at home

Slowly increase activity levels
People often increase activity levels too quickly, which can set them back. Occupational therapists working with people with long-term fatigue may only increase activity levels every couple of weeks. So, go slow and steady with activities and avoid pushing through fatigue.

Work
You may need longer off work than initially anticipated. A phased return works best which is planned with your manager and, if you have one, your occupational health department. You may also need a fit note from your GP. Try to avoid returning to work too soon and without the adjustments that you need to manage fatigue.

Have fun
Remember the fun things in life. Often people only prioritise things that seem necessary as they return to daily life, but it's important to have a balance. Allow others to help with day-to-day tasks so you can save energy for the activities you enjoy.

Moving forward
You may start feeling better gradually. Your recovery from post-viral fatigue could take several months to a year or more. As you start to gradually improve, remember to keep a balance of quality **rest, routine and fun activities**. Stress and worry use energy, so give yourself time and be kind to yourself.

What if I am not improving?

Seek advice
- If after building up the pacing of your daily activities, you don't see any improvement in what you can do, then you should seek medical advice by speaking to your GP.
- Find out more about pacing your daily activities in the 'How to conserve your energy' guide.
- If you continue to feel extremely fatigued, then specialist fatigue services may be available to provide further guidance. Ask your GP about referral options.

If you have any doubts, please seek medical advice via current routes.

Website links
NHS Apps Library: nhs.uk/apps-library
NHS Every Mind Matters: nhs.uk/oneyou/every-mind-matters/sleep
'How to conserve your energy' guide: rcot.co.uk/conserving-energy

This guide is produced by the Critical Care Forum, Royal College of Occupational Therapists Specialist Section – Trauma and Musculoskeletal Health in partnership with the Yorkshire Fatigue Clinic.
It is published by the Royal College of Occupational Therapists and is endorsed by the Intensive Care Society.

rcot.co.uk | intensive care society 50 YEARS proud to be the voice of critical care since 1970 | Royal College of Occupational Therapists

How to manage post-viral fatigue after COVID-19: Practical advice for people who have recovered at home (May 2020)

[Conserving your energy - Practical advice for people during and after having COVID-19 (1).pdf]

How to conserve your energy
Practical advice for people during and after having COVID-19

When you are ill or recovering from an illness, you are likely to have less energy and feel tired. A simple task, such as putting on your shoes, can feel like hard work. This guide will help you to find ways to conserve your energy as you go about your daily tasks. By making these small changes you'll have more energy throughout the day.

The 3 Ps principle (Pace, Plan and Prioritise)
Learning to pace, plan and prioritise your daily activities will help you to save energy.

Pace
Pacing yourself will help you have enough energy to complete an activity. You'll recover faster if you work on a task until you are tired rather than exhausted. The alternative, doing something until you're exhausted, or going for the big push, means that you'll need longer to recover.

Example: climbing stairs

The pacing approach ✔	The big push approach ✖
Climb five steps, rest for 30 seconds and repeat. You won't need a long rest at the top and won't feel so tired the next day.	Climb all the stairs at once. You'll have to rest for 10 minutes at the top, and feel achy and tired the next day.

Top tips:
- Break activities up into smaller tasks and spread them throughout the day.
- Build rests into your activities, it's key to recharging your energy.
- Plan 30–40 minutes of rest breaks between activities.
- Sit and rest wherever possible.

Plan
Look at the activities you normally do on a daily and weekly basis, and develop a plan for how you can spread these activities out. If certain activities make you breathless or fatigued, rather than do them in one go, plan ahead to do them throughout the day. Change the time of an activity: instead of having a bath or shower in the morning when you are busy, have one in the evening. Do weekly activities such as gardening, laundry and food shopping on different days, with rest days in between.

Top tips:
- Collect all the items you need before you start a task.
- Specially adapted equipment is likely to make tasks easier. If you have an occupational therapist, ask them for further advice and support.
- You may get more done when family or friends are visiting and can help you.

Prioritise
Some daily activities are necessary, but others aren't. Ask yourself the following questions to find out which of yours are necessary:
- What do I need to do today? What do I want to do today?
- What can be put off until another day?
- What can I ask someone else to do for me?

rcot.co.uk | intensive care society 50 YEARS proud to be the voice of critical care since 1970 | Royal College of Occupational Therapists

How to conserve your energy: Practical advice for people during and after having COVID-19 (May 2020)

How to conserve your energy
Practical advice for people during and after having COVID-19

Top energy conserving tips:
- Don't hold your breath during any task.
- Try to avoid pulling, lifting, bending, reaching and twisting where possible.
- Push or slide items as much as possible, rather than lifting them.
- Bend with your knees rather than from your waist.

Practical tips for different activities of daily living

Washing and grooming

Pace	Plan	Prioritise
• Sit to wash your face, brush your teeth and dry your hair. Have rests after each. • Pat yourself dry rather than rubbing.	• Keep all the things you will need in the same place. • Put a mirror at face level when sitting. • Liquid soap lathers more quickly than a bar. • Use long-handled equipment, such as a long-handled sponge.	• Try dry shampoo. • Use electrical items, such as a toothbrush and razor etc.

Bathing and showering

Pace	Plan	Prioritise
• Allow plenty of time and take rests. • Sit in the shower if possible.	• Open an inside door to allow good ventilation. • Use long-handled equipment. • Equipment can help you get in and out of the bath or shower, such as a rail or chair.	• Is bathing an activity you enjoy and are willing to spend a lot of energy on? • Is a daily bath or shower necessary? • Can you have a strip wash at the sink instead during your early recovery?

Dressing

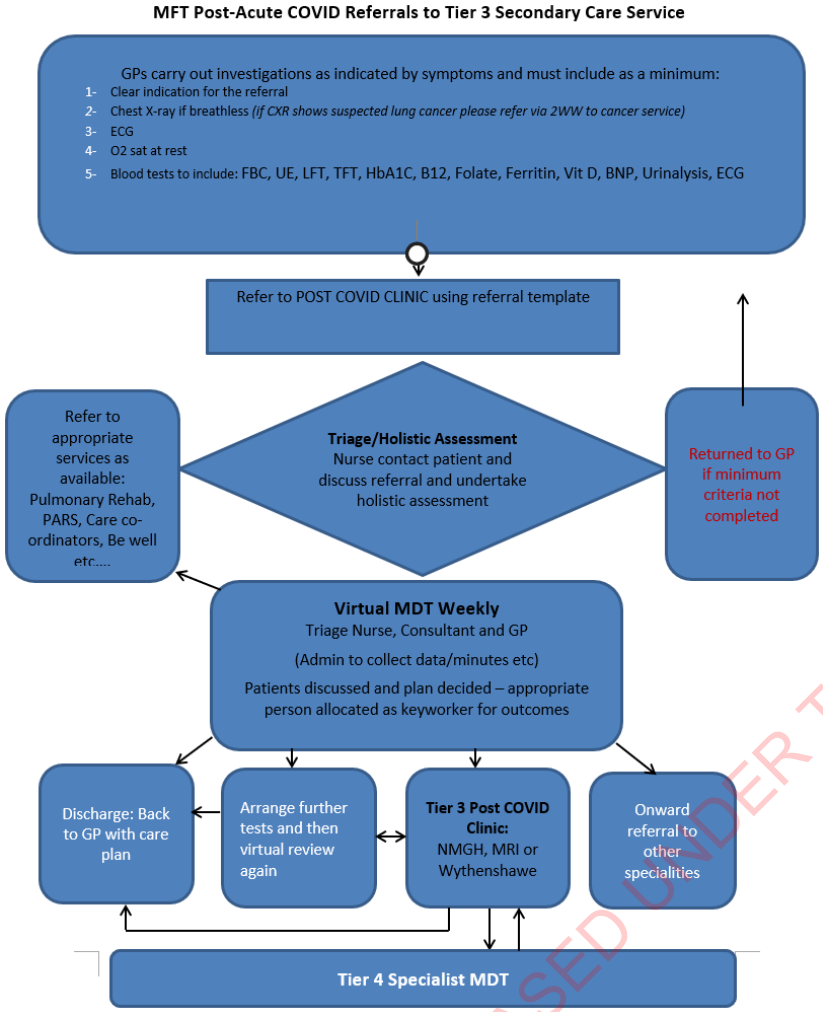
Pace	Plan	Prioritise
• Sit to dress. • Break up tiring tasks with easy ones and take rests. • Dress your lower half first, when you have the most energy.	• Collect all your clothes before you start. • Wear clothes that fasten at the front and are loose. • Put pants and trousers on at the same time and then pull them up together. • Put skirts on over your head. • Sit down to put on shoes and socks. Lift and cross one leg onto your knee to bring your foot closer.	• Can you rearrange your wardrobe and drawers so that all your clothes are close together? • Can a member of your household get your clothes out and help you get dressed?

rcot.co.uk | intensive care society 50 YEARS proud to be the voice of critical care since 1970 | Royal College of Occupational Therapists

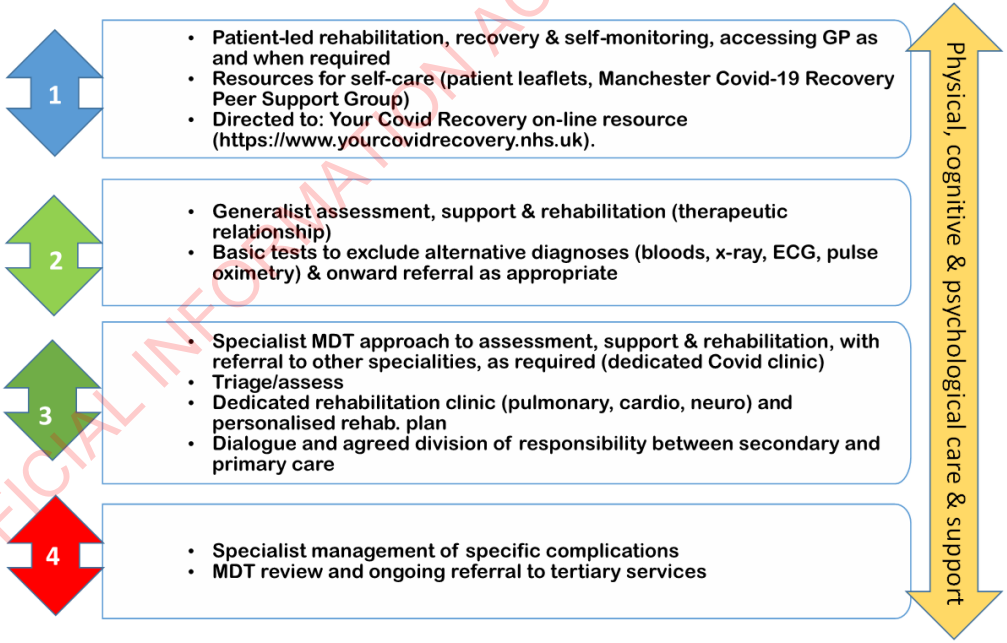
How to conserve your energy: Practical advice for people during and after having COVID-19 (May 2020)

Appendix 2 – Long COVID pathways

Trafford LC Service



4-Tier Integrated Service Model



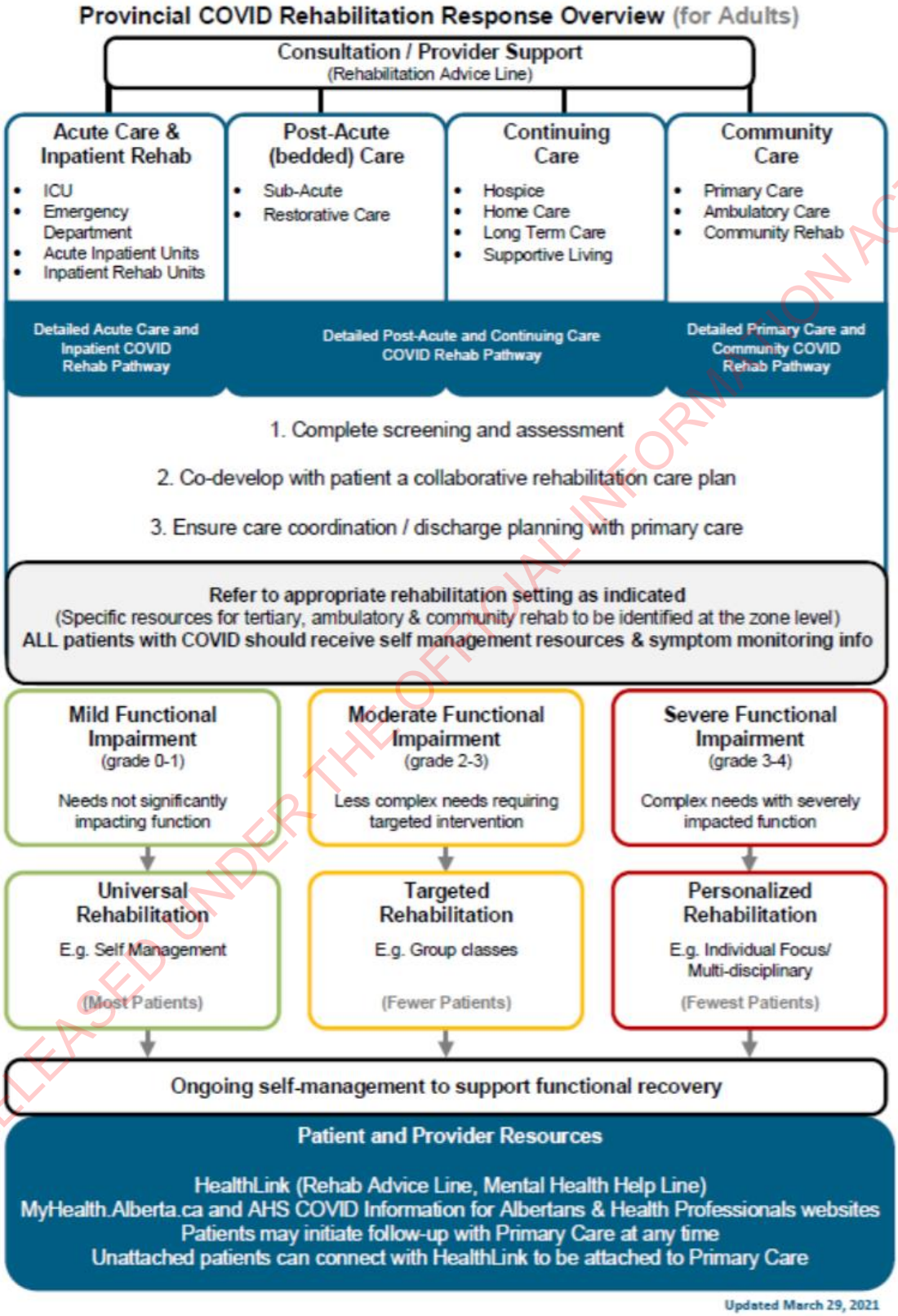
Copy of Post-Acute Covid Assessment Service referral template (to MFT South, Central and North sites)

Primary Care refferal template to

Range of COVID pathways that may be useful for care continuum (but excludes LC) Appendix 1 - TRAFFORD COVID RESPONSE PATHWAY DIRECTORY.pdf

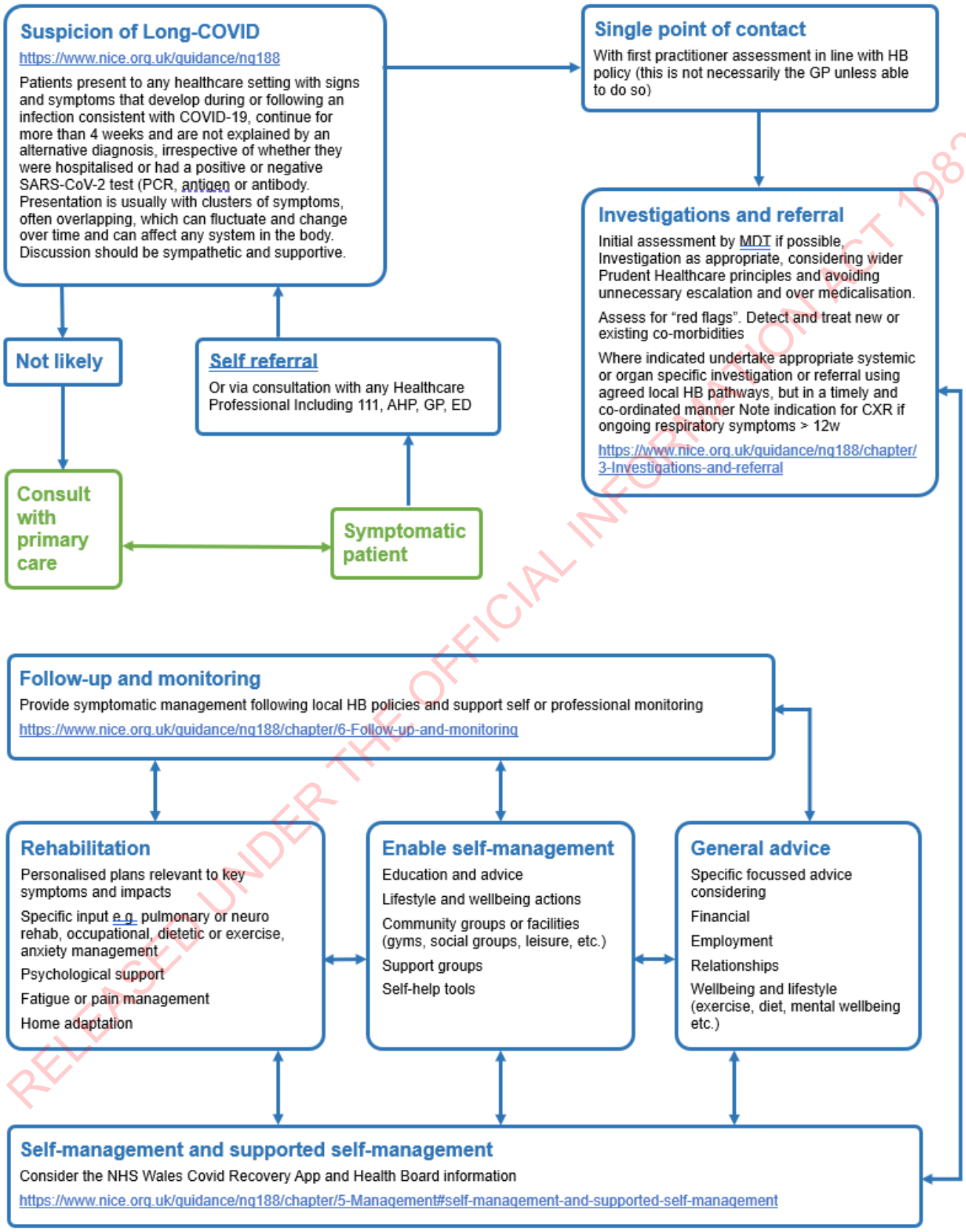
Alberta LC rehabilitation pathway

https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-post-covid-rehab-response-framework-summary.pdf



All Wales Community Pathway For Long COVID

https://gov.wales/all-wales-community-pathway-long-covid



Southwark Long COVID pathway Long-COVID-Pathway-September-2020.pdf

Proposed tele-rehabilitation pathway

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7369849/pdf/ijerph-17-04890.pdf

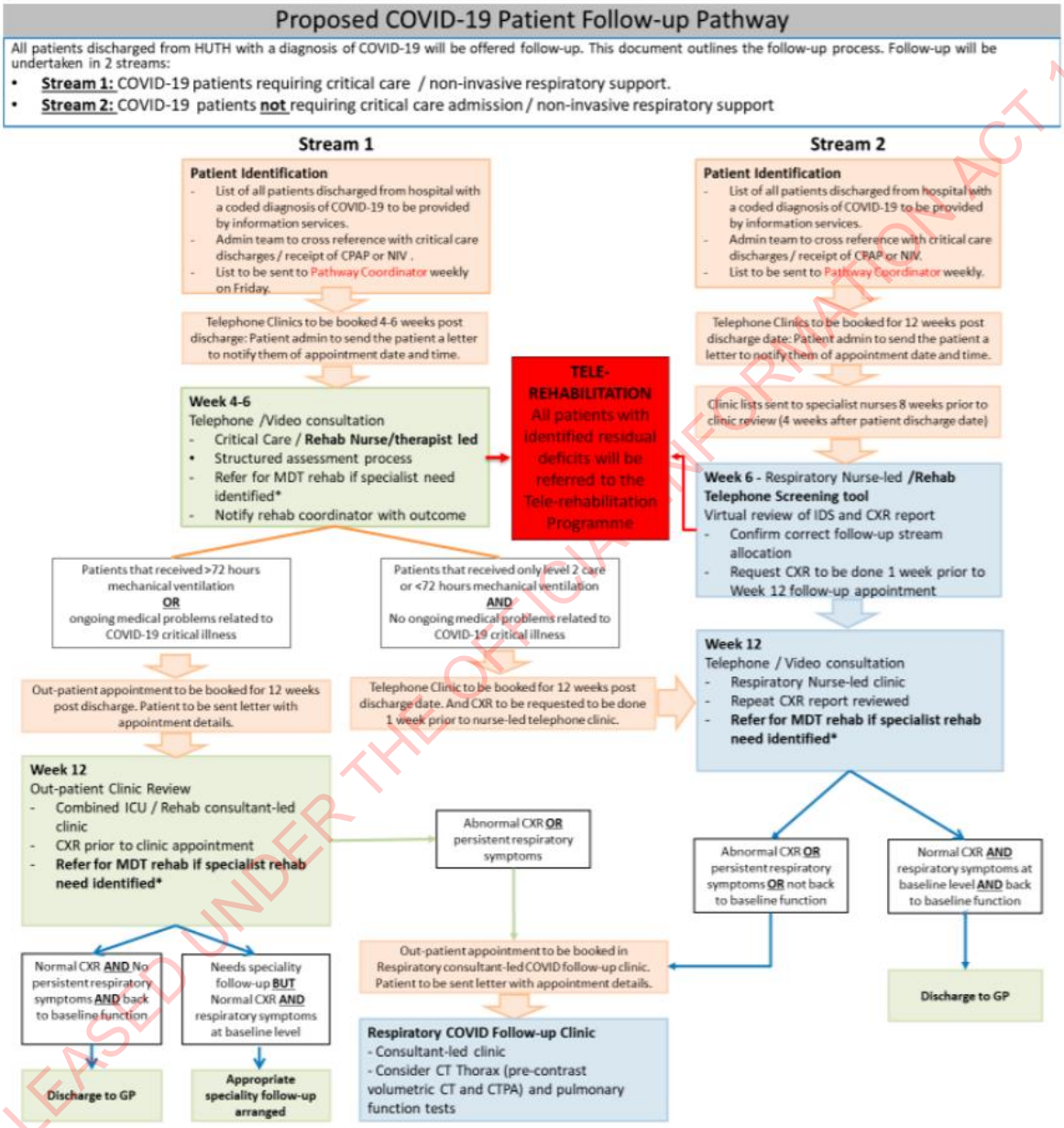


Figure 1. Proposed post-COVID-19 follow-up pathways. CPAP: continuous positive airway pressure; NIV: non-invasive ventilation; MDT: multi-disciplinary team; CXR: chest X-ray; ICU: intensive care unit; CT: computerized tomography; CTPA: computerized tomography pulmonary angiogram; and HUTH: Hull University teaching hospitals. * Specialist rehabilitation needs include but not limited to cognitive impairment, speech and swallowing difficulties, severe mobility and balance issues, and severe mood (anxiety and depression) issues.

1. Rotherham

Rotherham Long Covid Pathway – Management and Guidance

Post-COVID patient presents to GP with ongoing symptoms

Stratification of patients presenting includes:

- Acute COVID-19: signs and symptoms of COVID-19 for up to 4 weeks.
- Ongoing symptomatic COVID-19: signs and symptoms of COVID-19 from 4 to 12 weeks.
- Post-COVID-19 syndrome: signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis

GP consultation:

History and examination using Newcastle Screening tool. Investigations in primary care, as required based on symptoms – Management of post-acute covid-19 in primary care https://www.guidelines.co.uk/infection/nice-long-covid-guideline/455728.article Symptom Specific Recommended Management-see Table below

GP supports self-management of common symptoms

Provides the TRFT COVID-19 patient Rehabilitation Booklet LINK
and direct to the NHSE Post Covid-19 Online Support Tool: www.yourcovidrecovery.nhs.uk
If patient experiencing Anxiety, depression, OCD, PTSD make referral to IAPT Service
If patient could benefit from social prescribing support make a referral to the SP LTC service

Symptoms improve

→ **Care remains in Primary Care**

Symptoms do not improve but are singular need:

- refer to appropriate speciality

→ **Care remains in Primary Care**

Symptoms do not improve, are multiple and are significantly impacting on life:

- At referral to the Post-Covid 19 Assessment clinic patients would usually be expected to be 12+ weeks from initial COVID infection. Earlier than this many will improve with the above measures.
- Positive PCR or Ab tests are not essential but would usually be expected to substantiate the history of COVID infection after the first wave (March-April 2020) when testing was not widely available.
- Symptom based investigations must be completed or in process at the point of onward referral (see table below).

→ **Refer to Post Covid Hub for initial review and completion of Holistic Needs Assessment by PT/OT/Nurse**

→ **Access to Post Covid MDT Assessment Clinic & Covid community rehabilitation team (Medic, Psychologist, AHP & VAR – Cardiology & Respiratory input as needed))**

← **Refer to appropriate speciality as necessary**

→ **Appropriate follow up as necessary**

Proposed pathway from Austria systematic review (4)

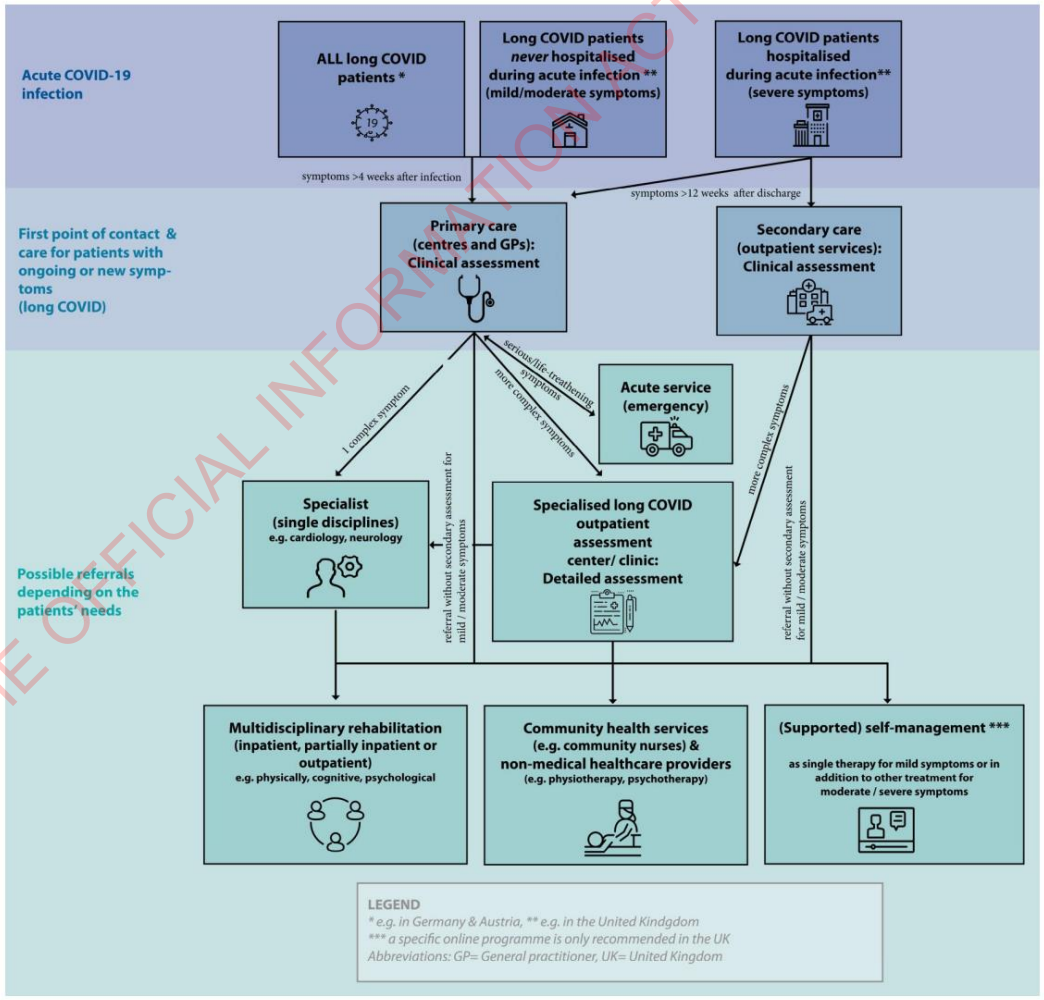


Figure 4-1: Possible long COVID healthcare pathways

A proposed care pathway for Long COVID

based on a rapid systematic review of care models for Long COVID - June 2021

SPOR EVIDENCE ALLIANCE | SPOR | COVID-END COVID-19 Evidence Network to support Decision-making ... in Canada

OVERARCHING PRINCIPLES

- Patient-centered care
- Patient empowerment
- Evidence-based care
- Integrated & coordinated care
- Shared & multidisciplinary care

Patient Pathway

People who had COVID in the community

New or ongoing symptoms

Primary care visit (4-12 wks)

Assessment and investigation of new or ongoing symptoms

Alternative diagnoses ruled out

People hospitalized with COVID

Post-discharge follow-up (6-8 wks)

Assessment and investigation of new or ongoing symptoms

Alternative diagnoses ruled out

Post-COVID Learning Ecosystem

Post-COVID assessment & triage

- Care and referral coordination
- Standardized assessment*
  - Respiratory issues
  - Fatigue & strength
  - Pain & discomfort
  - Sleep
  - Cognition
  - Mood & mental health
  - Nutrition & weight
  - Usual activities & occupation
  - Social determinants
- Personnel
  - Any physician
  - Trained healthcare professional

*COVID-19 Yorkshire Rehabilitation Scale and Newcastle Post-COVID Screening Tool

Tailored to patient needs

Referral according to patient needs

Rehabilitation

- Disability management (long term if needed)
- Targeted personnel
  - Physiotherapist
  - Occupational therapist
  - Nutrition
  - Speech & language therapist

Specialty care

- Further investigation for organ impairment & follow-up
- Targeted specialties
  - Pulmonary/respiratory
  - Cardiovascular
  - Psychiatry/psychology
  - Neurology
  - Hepatology
  - Otolaryngology
  - Dermatology

Primary care

- Care coordination
- Medication management
- Comorbidities management
- Self-management support

→ Long-term follow-up

- Targeted personnel
  - General practitioner
  - Social worker
  - Nursing
  - Pharmacist

Provider support :

- Standardized assessment
- EMR template
- Referral and follow-up system
- Training

Patient support :

- Home-based care
- Patient education
- Patient support groups
- Telehealth / virtual care

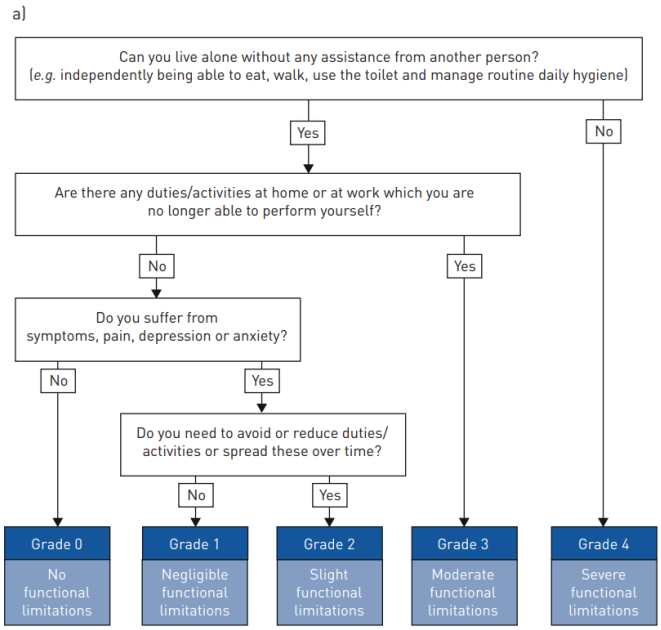
OUTCOMES

- Quality of life
- Patient experience
- Provider experience
- Sustainable cost

Components were included in the proposed pathway based on the frequency of their occurrence in the literature ; efficacy data was not available at the time of the review.
Source : Decary S, Dugas M, Stefan T, Langlois L, Skidmore B, Bhéreur A, and LeBlanc A. (2021). Care Models for Long COVID – A Rapid Systematic Review. SPOR Evidence Alliance, COVID-END Network.

Appendix 3 - Measures

The Post-COVID-19 Functional Status



b)

How much are you currently affected in your everyday life by COVID-19? (Please indicate which one of the following statements applies to you most)	Corresponding PCFS scale grade
I have no limitations in my everyday life and no symptoms, pain, depression or anxiety related to the infection.	0
I have negligible limitations in my everyday life as I can perform all usual duties/ activities, although I still have persistent symptoms, pain, depression or anxiety.	1
I suffer from limitations in my everyday life as I occasionally need to avoid or reduce usual duties/activities or need to spread these over time due to symptoms, pain, depression or anxiety. I am, however, able to perform all activities without any assistance.	2
I suffer from limitations in my everyday life as I am not able to perform all usual duties/ activities due to symptoms, pain, depression or anxiety. I am, however, able to take care of myself without any assistance.	3
I suffer from severe limitations in my everyday life: I am not able to take care of myself and therefore I am dependent on nursing care and/or assistance from another person due to symptoms, pain, depression or anxiety.	4

FIGURE 1 Patient self-report methods for the Post-COVID-19 Functional Status (PCFS) scale. a) Flowchart. b) Patient questionnaire. Instructions for use: 1) to assess recovery after the SARS-CoV-2 infection, this PCFS scale covers the entire range of functional limitations, including changes in lifestyle, sports and social activities; 2) assignment of a PCFS scale grade concerns the average situation of the past week (exception: when assessed at discharge, it concerns the situation of the day of discharge); 3) symptoms include (but are not limited to) dyspnoea, pain, fatigue, muscle weakness, memory loss, depression and anxiety; 4) in case two grades seem to be appropriate, always choose the highest grade with the most limitations; 5) measuring functional status before the infection is optional; 6) alternatively to this flowchart and patient questionnaire, an extensive structured interview is available. The full manual for patients and physicians or study personnel is available from https://osf.io/qgpdv/ (free of charge).

Box: Items of the long COVID symptom and impact tools (ST and IT)

Check the symptoms you experienced in the last 30 days:

General symptoms
- Weight loss
- Loss of appetite
- Sweats
- Fever and chills
- Hot flushes
- Fatigue
- Sleeping more
- Difficulty sleeping
- Heat/Cold intolerance
- Changing mood/impact on morale
- Body aches

Thorax
- Rib cage pain
- Chest pressure
- Sharp sudden pain, chest burns
- Tachycardia/Bradycardia/palpitations/Arrhythmia
- Cough
- Dyspnea

Neurological
- Headache
- Tremor
- Dizziness/Malaise
- Balance disorder
- Word finding problems
- Brain fog/Difficulty concentrating
- Memory problems
- Paraesthesia (pricking, tingling, or creeping on the skin)
- Impaired/decreased tactile sensibility
- Change/loss of taste
- Change/loss of smell

Digestive
- Abdominal pain
- Nausea/Vomiting
- Diarrhea

Ear/Nose/Throat
- Sore throat/tongue/mouth/dysphagia
- Ear pain
- Clogged ears
- Tinnitus
- Congested/Runny nose

Eyes
- Dry eyes
- Blurry vision
- Photophobia/Phonophobia

Musculoskeletal
- Bone and joint pain
- Heavy legs/swelling of the legs
- Muscle aches
- Neck, back, and low back pain

Blood and lymph circulation
- Circulatory problems (including bulging veins)
- Spontaneous bruises
- Swollen lymph nodes
- High or low blood pressure

Skin and hair
- Dry/peeling skin
- Hair loss
- Skin rash
- Discoloration/swelling of hands and feet

Urinary and gynaecological
- Gynecological problems
- Urinary symptoms

Assess the impact of your illness during the last 30 days . . .
- On your personal activities (not being able to do personal activities, driving a vehicle)
- On your family life (feeling isolated or as a burden to others, having to ask for help, not being able to do household chores or take care of your family)
- On your professional life (having to stop working, being unable to work as well as before)
- On your social life (avoiding relationships because of the way people look at you, coping with others not taking your disease seriously, being afraid of infecting others)
- On your morale/mood (low morale, feeling that life is passing you by, fearing of the future or not recovering)
- On your relationship with caregivers (guilt, taking the illness seriously, lack of response, complexity of the care pathway)

Validated Patient Long COVID Symptom tool (30)

C19-YRS tool

Covid 19 Yorkshire Rehab Screen (C19-YRS)

Patient name and NHS number:

Time and date of call:

Staff member making call:

We are getting in touch with people who have been discharged after having had a diagnosis of coronavirus disease (Covid-19). The purpose of this call is to find out if you are experiencing problems related to your recent illness with coronavirus. We will document this in your clinical notes. We will use this information to direct you to services you may need and inform the development of these services in the future.

This call will take around 15 minutes. If there's any topics you don't want to talk about you can stop the conversation at any point. Do you agree to talk to me about this today? **Yes ☐ No ☐**

Opening questions:

Have you had any further medical problems or needed to go back to hospital since your discharge? Re-admitted? **Yes ☐ No ☐** Details:
Have you used any other health services since discharge (e.g. your GP?) **Yes ☐ No ☐** Details:

I'll ask some questions about how you might have been affected since your illness. If there are other ways that you've been affected then there will be a chance to let me know these at the end.			
1. Breathlessness	On a scale of 0-10, with 0 being not breathless at all, and 10 being extremely breathless, how breathless are you: (n/a if does not perform this activity)	Now	Pre-Covid
	a) At rest?	0-10: ____	0-10: ____
	b) On dressing yourself?	0-10: ____ N/a ☐	0-10: ____ N/a ☐
	c) On walking up a flight of stairs?	0-10: ____ N/a ☐	0-10: ____ N/a ☐

2. Laryngeal/ airway complications	Have you developed any changes in the sensitivity of your throat such as troublesome cough or noisy breathing? **Yes ☐ No ☐** If Yes: rate the significance of impact on a scale of 0-10 (0 being no impact, 10 being significant impact) **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
3. Voice	Have you or your family noticed any changes to your voice such as difficulty being heard, altered quality of the voice, your voice tiring by the end of the day or an inability to alter the pitch of your voice? **Yes ☐ No ☐** If Yes: rate the significance of impact on a scale of 0-10 (0 being no impact, 10 being significant impact) **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
4. Swallowing	*Are you having difficulties eating, drinking or swallowing such as coughing, choking or avoiding any food or drinks?* **Yes ☐ No ☐** If Yes: rate the significance of impact on a scale of 0-10 (0 being no impact, 10 being significant impact) **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
5. Nutrition	Are you or your family concerned that you have ongoing weight loss or any ongoing nutritional concerns as a result of Covid-19? **Yes ☐ No ☐** Please rank your appetite or interest in eating on a scale of 0-10 since Covid-19 (0 being same as usual/no problems, 10 being very severe problems/reduction) **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
6. Mobility	On a 0-10 scale, how severe are any problems you have in walking about? 0 means I have no problems, 10 means I am completely unable to walk about. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
7. Fatigue	Do you become fatigued more easily compared to before your illness? **Yes ☐ No ☐** If yes, how severely does this affect your mobility, personal cares, activities or enjoyment of life? (0 being not affecting, 10 being very severely impacting) Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
8. Personal-Care	On a 0-10 scale, how severe are any problems you have in personal cares such as washing and dressing yourself? 0 means I have no problems, 10 means I am completely unable to do my personal care. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
9. Continence	Since your illness are you having any <u>new</u> problems with: • controlling your bowel **Yes ☐ No ☐** • controlling your bladder **Yes ☐ No ☐**

10. Usual Activities	On a 0-10 scale, how severe are any problems you have in do your usual activities, such as your household role, leisure activities, work or study? 0 means I have no problems, 10 means I am completely unable to do my usual activities. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
11. Pain/ discomfort	On a 0-10 scale, how severe is any pain or discomfort you have? 0 means I have no pain or discomfort, 10 means I have extremely severe pain Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
12. Cognition	Since your illness have you had new or worsened difficulty with: • concentrating? **Yes ☐ No ☐** • short term memory? **Yes ☐ No ☐**
13. Cognitive-Communication	*Have you or your family noticed any change in the way you communicate with people, such as making sense of things people say to you, putting thoughts into words, difficulty reading or having a conversation?* **Yes ☐ No ☐** If Yes: rate the significance of impact on a scale of 0-10 (0 being no impact, 10 being significant impact) **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
14. Anxiety	On a 0-10 scale, how severe is the anxiety you are experiencing? 0 means I am not anxious, 10 means I have extreme anxious. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
15. Depression	On a 0-10 scale, how severe is the depression you are experiencing? 0 means I am not depressed, 10 means I have extreme depression. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
16. PTSD screen	a) Have you had any unwanted memories of your illness or hospital admission whilst you were awake, so not counting dreams? **Yes ☐ No ☐** If yes, how much do these memories bother you? (is the distress: **mild ☐ / moderate ☐ / severe ☐ / extreme ☐**) b) Have you had any unpleasant dreams about your illness or hospital admission? **Yes☐ No☐** If yes, how much do these dreams bother you? (is the distress: **mild ☐ / moderate ☐ / severe ☐ / extreme ☐**) c) Have you tried to avoid thoughts or feelings about your illness or hospital admission? **Yes ☐ No ☐** If yes, how much effort do you make to avoid these thoughts or feelings? (**mild ☐ / moderate ☐ / severe ☐ / extreme ☐**) d) Are you currently having thoughts about harming yourself in any way? **Yes ☐ No ☐**

17. Global Perceived Health	How good or bad is your health overall? 10 means the best health you can imagine. 0 means the worst health you can imagine. Now: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐** Pre-Covid: **0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐**
18. Vocation	What is your employment situation and has your illness affected your ability to do your usual work? Occupation: _____ Employment status before Covid-19 Lockdown: _____ Employment status before you became ill: _____ Employment status now: _____
19. Family/carers views	Do you think your family or carer would have anything to add from their perspective?

Closing questions:

Are you experiencing any other new problems since your illness we haven't mentioned? Any other discussion (clinical notes):

POST COVID-19 RECOVERY CLINIC
BASELINE QUESTIONNAIRE

Questionnaire completed on: (dd/mmm/yyyy) _____
Clinic visit date: (dd/mmm/yyyy) _____ *(if different from completion date)*

1. PATIENT DEMOGRAPHICS

Name: _____ _____ _____
Last *First* *Middle*

Date of Birth: (dd/mmm/yyyy) _____/_____/_____

What is your living situation? Please check ONE answer for each question.

I live:
- ☐ Alone
- ☐ With other(s)

My primary residence (home) is:
- ☐ A house or townhouse or mobile home
- ☐ A condo or apartment
- ☐ An assisted-living facility
- ☐ I do not have a home

Are you employed? ☐ Yes ☐ No
If Yes, what is your occupation: _____
Industry of employment: _____
Do you work:
- ☐ Full time (regular hours)
- ☐ Part time (greater than 50% of regular hours)
- ☐ Part time (less than 50% of regular hours)
- ☐ Unable to work following COVID-19 illness

What is your ethnicity?
- ☐ White (Caucasian)
- ☐ Indigenous
- ☐ Black (e.g. African, Somali)
- ☐ Latin American
- ☐ Asian: (specify) _____
- ☐ Other: (specify) _____

2. SMOKING HISTORY

Have you ever smoked cigarettes? ☐ Yes ☐ No
If Yes: Do you smoke cigarettes now (at least 1 per day for the past year)? ☐ Yes ☐ No
What year did you start smoking? _____
What year did you stop smoking? _____ (if you are still smoking mark N/A) ☐ N/A
On average, how any cigarettes do/did you smoke per day? _____
Did you use vaping products in the 3 months before you had COVID-19? ☐ Yes ☐ No
Did you smoke marijuana in the 3 months before you had COVID-19? ☐ Yes ☐ No

2. COVID-19 HISTORY

Which of the following symptoms were new or worse than usual when you had COVID-19?	New or worse symptoms just before or during admission to hospital	Symptoms still present
Shortness of breath	☐	☐
Cough	☐	☐
Sore throat	☐	☐
Chest congestion (phlegm production)	☐	☐
Chest pain	☐	☐
Palpitations	☐	☐
Headache	☐	☐
Fever	☐	☐
Fatigue	☐	☐
Weakness	☐	☐
Loss of taste and smell	☐	☐
Hoarse voice/change in voice	☐	☐
Nausea or vomiting	☐	☐
Diarrhea	☐	☐
Muscle or joint aches	☐	☐
Rashes	☐	☐
Discolouration of fingers or toes	☐	☐
Other (specify):	☐	☐

When did your first symptom(s) start? (dd/mmm/yyyy) _____/_____/_____
Do your symptoms fluctuate in severity? ☐ Yes ☐ No
Are your symptoms brought on by: ☐ Physical exertion ☐ Cognitive tasks ☐ Emotional events
Do your symptoms improve with rest? ☐ Yes ☐ No

3. MEDICAL STATUS

Please answer "Yes" or "No" for all the items below as they apply to you now.
If you are unsure, please select the option that feels most appropriate to you.

Long term disabilities or handicaps	☐ Yes	☐ No
Restriction of activity due to poor health	☐ Yes	☐ No
Help for preparing meals	☐ Yes	☐ No
Help for shopping for necessities	☐ Yes	☐ No
Help for housework	☐ Yes	☐ No
Help for heavy household chores	☐ Yes	☐ No
Help for personal care	☐ Yes	☐ No
Help for moving inside house	☐ Yes	☐ No
Food allergies	☐ Yes	☐ No
Asthma	☐ Yes	☐ No

6. QUALITY OF LIFE

Under each heading, tick ONE box that best describes your health TODAY.

MOBILITY
- ☐ I have no problems walking about
- ☐ I have slight problems walking about
- ☐ I have moderate problems walking about
- ☐ I have severe problems walking about
- ☐ I am unable to walk about

SELF-CARE
- ☐ I have no problems washing or dressing myself
- ☐ I have slight problems washing or dressing myself
- ☐ I have moderate problems washing or dressing myself
- ☐ I have severe problems washing or dressing myself
- ☐ I am unable to wash or dress myself

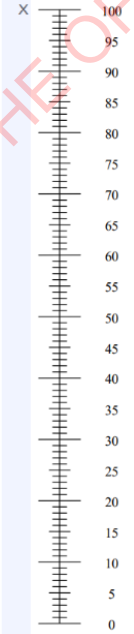
USUAL ACTIVITIES *(e.g. work, study, housework, family or leisure activities)*
- ☐ I have no problems doing my usual activities
- ☐ I have slight problems doing my usual activities
- ☐ I have moderate problems doing my usual activities
- ☐ I have severe problems doing my usual activities
- ☐ I am unable to do my usual activities

PAIN / DISCOMFORT
- ☐ I have no pain or discomfort
- ☐ I have slight pain or discomfort
- ☐ I have moderate pain or discomfort
- ☐ I have severe pain or discomfort
- ☐ I have extreme pain or discomfort

ANXIETY / DEPRESSION
- ☐ I am not anxious or depressed
- ☐ I am slightly anxious or depressed
- ☐ I am moderately anxious or depressed
- ☐ I am severely anxious or depressed
- ☐ I am extremely anxious or depressed

To move the X on this scale: Place your cursor in front of the "X" and click return on your keyboard until the X is in position next to the number you want to record.

The best health you can imagine



The worst health you can imagine

We would like to know how good or bad you feel your health is TODAY.
The scale to the right, is numbered from 0 to 100.
100 means the BEST health you can imagine.
0 means the WORST health you can imagine.
Mark an X on the scale to indicate how you feel your health is TODAY.
Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY = _____

7. NEUROLOGY SCREEN

Have you experienced any of the following symptoms?	**Symptom present before COVID illness**	**Symptom new or much worse during acute COVID illness**	**Symptom experienced at present**
Weakness in face, arms, or legs (or all)	☐	☐	☐
Numbness/loss of feeling in face, arms, or legs (or all)	☐	☐	☐
Shooting, stabbing or burning pains, muscle aches	☐	☐	☐
Muscle stiffness or slowness of movement	☐	☐	☐
Headache, neck stiffness or eye pain with eye movements	☐	☐	☐
Loss of the ability to speak or understand what others are saying, slurred speech	☐	☐	☐
Memory problems, searching for words, slowed thinking	☐	☐	☐
Loss of consciousness, reduced awareness, coma	☐	☐	☐
Tremor (shaking)	☐	☐	☐
Muscle twitches or involuntary movements	☐	☐	☐
Seizures	☐	☐	☐
Difficulty with walking or balance	☐	☐	☐
Vision loss in one or both eyes, double vision, blurry vision, trouble focusing	☐	☐	☐
Loss of sense of smell or taste	☐	☐	☐
Tinnitus (ringing in your ears)	☐	☐	☐
Hearing loss	☐	☐	☐
Bowel or bladder problems	☐	☐	☐
Dizziness, spinning, unsteadiness	☐	☐	☐
Trouble with sleep, including falling/staying asleep, poor quality sleep, acting out dreams (talking, kicking, etc.)	☐	☐	☐

post_covid-19_recovery_clinic_baseline_questionnaire.pdf

Alberta Health Services

Post COVID-19 Patient in Continuing Care Screening

Last Name *(Legal)*	First Name *(Legal)*	
Preferred Name ☐ Last ☐ First	DOB *(dd-Mon-yyyy)*	
PHN	ULI ☐ Same as PHN	MRN
Administrative Gender ☐ Male ☐ Female ☐Non-binary/Prefer not to disclose (X) ☐ Unknown		

This screening will be kept on your patient chart. If you respond "YES" **to questions 3 or 4**, notify your case manager or most responsible health care provider **to ensure that any additional care needs are assessed**.

1. Have you ever received a lab confirmed, positive test result for COVID-19?
   ☐ Yes
   ☐ No ▶ If no is checked, **STOP HERE**. Assessment is complete, and no further information is required.

   Comments

2. Following your COVID-19 illness, have you ever been told that you had Post Intensive Care Syndrome (PICS), Post Viral Fatigue Syndrome (PVFS), Permanent Organ Damage (POD) or Long Term COVID Syndrome (LTCS)?
   ☐ Yes
   ☐ No

   Comments

3. Are you back to doing your usual activites? *(e.g., walking, self-care, work, school, hobbies; continuing care patients as per existing care plan)*
   ☐ Yes
   ☐ No ▶ If you answered no, what is preventing you from returning to those activities? *(comment below)*

   Comments

4. Are you experiencing any new, worsening or ongoing symptoms since your COVID-19 illness?
   Indicate assessment of symptom by documenting:
   A *(absent)*, **PS** *(pre-existing same)*, **PW** *(pre-existing worse)*, **NS** *(new since COVID-19 stable/improving)*, **NW** *(new since COVID-19 worse)* in the box beside each symptom.

Respiratory Symptoms		Psychological Symptoms	
	Shortness of breath/difficulty breathing at rest		Depression *(e.g. recurring sadness, isolating oneself, frequent negative thoughts)*
	Shortness of breath/difficulty breathing with activity		Anxiety *(e.g. fear, worry)*
	Cough		

21790 (Rev2021-09) Side A

Alberta Health Services

Post COVID-19 Patient in Continuing Care Screening

Last Name *(Legal)*	First Name *(Legal)*	
Preferred Name ☐ Last ☐ First	DOB *(dd-Mon-yyyy)*	
PHN	ULI ☐ Same as PHN	MRN
Administrative Gender ☐ Male ☐ Female ☐Non-binary/Prefer not to disclose (X) ☐ Unknown		

4. Are you experiencing any new, worsening or ongoing symptoms since your COVID-19 illness? ***(continued)***
   Indicate assessment of symptom by documenting:
   A *(absent)*, **PS** *(pre-existing same)*, **PW** *(pre-existing worse)*, **NS** *(new since COVID-19 stable/improving)*, **NW** *(new since COVID-19 worse)* in the box beside each symptom.

Cardiovascular Symptoms		Neurological Symptoms	
	Chest pain at rest		Issues with concentration, thiking or memory *(e.g. brain fog)*
	Chest pain with activity		Headaches
	Palpitations		Difficulty hearing
	Dizziness or fainting		Ringing in the ears
Gastrointestinal Symptoms			Pins and needles/numbness
	Nausea and/or vomiting		Difficulty hearing
	Senses of taste/smell been affected		Ringing in the ears
	Difficulty eating/drinking/swallowing *(e.g. choking, painful swallowing, coughing while eating/drinking)*		Pins and needles/numbness
	Eating less than usual for more than 1 week	**Musculoskeletal Symptoms**	
	Lost/gained a significant amount of weight without trying		Pain/discomfort *(including muscle/joint pain)*
	Include amount of Weight gain/loss, for loss indicate a negative number: _____ *(kg)*		Pain orientation *(e.g. right, anterior)* _____
	Difficulty with bowels *(e.g. diarrhea, constipation)*		Pain location *(e.g. groin)* _____
	Difficulty with bladder *(e.g. incontinence/leakage secondary to cough)*		Generalized muscle weakness
			Difficulty controlling the movement of body *(loss of coordination)*
			Difficulty walking *(sense of imbalance)*

Other Symptoms	
	Fever *(describe, e.g., in the evenings, with activity, unexplained, or unexplained fever that comes and goes)*
	Fatigue/low energy
	Difficulty sleeping
	Additional symptoms *(specify)* _____

Assessed by	Date *(dd-Mon-yyyy)*	Time

21790 (Rev2021-09) Side B

Alberta Screening https://www.albertahealthservices.ca/frm-21790.pdf

Part 2: Post COVID Symptom Checklist

Sample Script: The next part of the survey we will be discussing any symptoms you are currently experiencing as a result of COVID-19. The symptoms are divided into categories which will help us determine how to best direct your recovery. If you have no symptoms in a category, please indicate N/A and we will move on to the next section. If you are unsure, we will ask more detailed questions. For each question, please indicate if your symptoms are **worse**, the **same** or **better** than before your illness.

Cardiorespiratory Symptoms? ☒ Yes ☐ N/A ☐ Unsure		**Neurological Symptoms?** ☐ Yes ☐ N/A ☐ Unsure	
Shortness of breath at rest? ☐ N/A	☐ Worse ☐ Same ☐ Better	Difficulty controlling the movement of your body? ☐ N/A	☐ Worse ☐Same ☐ Better
Shortness of breath with activity? ☐ N/A	☐ Worse ☐ Same ☐ Better	Difficulty eating, drinking or swallowing (i.e. choking)? ☐ N/A	☐ Worse ☐ Same ☐ Better
Lingering cough or noisy breathing? ☐ N/A	☐ Worse ☐ Same ☐ Better	Difficulty controlling your: Bowels? ☐ N/A	☐ Worse ☐ Same ☐ Better
Chest pain at rest? ☐ N/A	☐ Worse ☐ Same ☐ Better	Bladder? ☐ N/A	☐ Worse ☐ Same ☐ Better
Chest pain with activity? ☐ N/A	☐ Worse ☐ Same ☐ Better	Issues with concentration, thinking or memory? ☐ N/A	☐ Worse ☐ Same ☐ Better
Dizziness, fainting or loss of consciousness? ☐ N/A	☐ Worse ☐ Same ☐ Better	Difficulty hearing? ☐ N/A	☐ Worse ☐ Same ☐ Better
		Difficulty seeing? ☐ N/A	☐ Worse ☐ Same ☐ Better
Musculoskeletal Symptoms? ☐ Yes ☐ N/A ☐ Unsure		**Other Symptoms?** ☐ Yes ☐ N/A ☐ Unsure	
Generalized muscle weakness? ☐ N/A	☐ Worse ☐ Same ☐ Better	Extreme fatigue/exhaustion? ☐ N/A	☐ Worse ☐ Same ☐ Better
Muscle or joint pain? ☐ N/A	☐ Worse ☐ Same ☐ Better	Worse after physical or mental activity?	☐Yes ☐ No
Difficulty walking? ☐ N/A	☐ Worse ☐ Same ☐ Better	Have you lost your taste or sense of smell?	☐Yes ☐ No
Difficulty doing own washing & dressing? ☐ N/A	☐ Worse ☐ Same ☐ Better	Have you been eating less than usual for more than 1 week?	☐Yes ☐ No
Difficulty doing your usual activities (i.e. leisure or work)? ☐ N/A	☐ Worse ☐ Same ☐ Better	Have you lost or gained a significant amount of weight without trying?	☐Yes ☐ No ☐Lost ☐ Gained
Mood Related Symptoms? ☐ Yes ☐ N/A ☐ Unsure		Issues with pain or discomfort? ☐ N/A	☐ Worse ☐ Same ☐ Better
Experiencing anxiety? ☐ N/A	☐ Worse ☐ Same ☐ Better	Difficulty sleeping? ☐ N/A	☐ Worse ☐ Same ☐ Better
Experiencing depression? ☐ N/A	☐ Worse ☐ Same ☐ Better	Headaches? ☐ N/A	☐ Worse ☐ Same ☐ Better

* Upon completion, providers should ask clients about additional symptoms that may have been missed.

Appendix 4 - Useful Resources

Guides for patients:

Irish Society of Chartered Physiotherapists Guide.pdf (Command Line)

Conserving your energy - Practical advice for people during and after having COVID-19.pdf

Humber Long COVID Triage & Assessment Service – Post COVID-19 Patient information pack

Patient information pack.pdf (Command Line)

Recovering-after-Coronavirus-COVID-19.pdf (Command Line)

Guidance for healthcare professionals on return to work for patients with long-COVID

longCOVID_guidance_Occupational_Health.pdf (Command Line)

GP Gateway resources: https://www.coventryrugbygpgateway.nhs.uk/pages/post-covid-syndrome-pathway/

Resources for Rehabilitation & Allied Health Practice: https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-rehab-allied-health-practice-considerations-post-covid.pdf

http://www.phsa.ca/health-info/post-covid-19-care-recovery

https://world.physio/sites/default/files/2021-07/Briefing-Paper-9-Long-Covid-FINAL-English-202107.pdf

Document 4

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

This form contains the details relevant to the questions posed to the Science and Technical Advisory (STA). STA will respond to the request using this form which will also be stored in STA content management system for future reference.

This form, or parts of it, may also be forwarded to other relevant parties as appropriate.

Title	Long COVID Evidence Update		
Subject	Underlying science and long-term health impacts of COVID-19		
Reference No.	501	Date Received	3/02/2022
Requestor	Martin Chadwick, Chief Allied Health Professions Officer from the Ministry of Health.	Date Due	20/05/2022
Advisor	Eloise Williams, Senior Advisor Sarah Mitchell, Senior Advisor Fiona Stephens, Senior Advisor Brooke Hollingshead, Team Leader	Date Completed	20/05/2022
Peer reviewed by	Dan Bernal, Manager, Science & Technical Advisory		
Advice issued to	Martin Chadwick, Chief Allied Health Professions Officer		
Approved by	Dan Bernal, Manager, Science & Technical Advisory		
Deliverables	A review of the evidence and health impacts on long-term effects of COVID-19		

Request Outline

Background/Context

In developing a work programme for long COVID, CAPHO have requested a regular update on what is known about the science and evidence on long COVID, and awareness of what other countries are establishing to support people with this condition.

Questions

Long COVID terminology and definitions	• What are the various terms used to describe ongoing health effects following the acute COVID-19 illness? • What are the clinical case definitions used by various organisations/ countries?
Diagnosis	• What are the limitations or challenges in making a diagnosis of long COVID? • Are there any tests available to assist with diagnosing the condition? (e.g., immune function tests)

Symptoms and signs	• Outline the range of symptoms and signs that have been associated with long COVID • Which symptoms are most common? • Disease course - pattern and severity of symptoms • Is there any association between particular variants and the types of long COVID symptoms?
Psychosocial impacts	• What kinds of mental health impacts are long COVID patients experiencing? • What impact can long COVID have on ability to work? • How does long COVID impact on quality of life overall?
Prevalence/ incidence	• What is the estimated prevalence of long COVID in various groups, including by: age (including children), ethnicity (including Indigenous), remote/rural geography, social and economic status, gender, severity of initial infection, hospitalised vs non-hospitalised, and at various timeframes after the acute illness?
	• What is the estimated prevalence of long COVID in key countries, according to sources in country? Which demographics have been most impacted by long COVID (e.g. in terms of gender, age, and ethnicity)? Key countries could include: Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain.
Aetiology	• What are the proposed mechanisms which contribute to the development of long COVID?
Risk factors	• What are the risk factors for developing long COVID?
Treatment and support	• Are there established treatments and supports known to help patients with long COVID? • What are the other treatments being investigated for long COVID patients? • What models of care are other countries putting in place/ exploring? • What guidelines do other countries/ organisations have in place for rehabilitation of patients with long COVID?

Prevention (see also, vaccination)	• Aside from vaccination, are there any other ways to reduce the risk of developing long COVID once infected with SARS-CoV-2? (e.g. importance of rest during acute illness)
Vaccination	• Does vaccination before infection reduce the symptoms or incidence of long COVID? • Does previous vaccination affect severity of symptoms in people with long COVID? • Is it considered safe for patients with long COVID to receive COVID-19 vaccines? • Does vaccination of patients with existing long COVID affect their symptoms/ disease course?
Social and economic impact	• What are the current and projected economic impacts of long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain, according to sources in country? *(Including workforce impacts such as sick days/absences, financial costs to employers, impacts on particular sectors).*
Policy responses	• How have governments responded to long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain, according to sources in country? • Has the government classed long COVID as a disability? • What social support schemes are available for people with long COVID? • What are government recommendations to employers around how to manage employees with long COVID? • What are the current treatment pathways available for those facing long COVID and what barriers are people facing in accessing these pathways?

Intended application of advice

To inform development of support packages and rehabilitation pathways for people with long COVID

Timeline

First evidence update to be sent on Friday 20 May 2022

	Ongoing updates to be provided every six to eight weeks
What are the implications and considerations of this advice on Te Tiriti o Waitangi and equity?	COVID-19 has disproportionately affected vulnerable populations and exacerbated existing inequities, and the burden of long COVID is likely to continue this trend. In New Zealand, Māori and Pacific peoples make up an increasing proportion of COVID-19 cases, so it is possible that long COVID may have a particularly high burden in these populations who already face a range of challenges. They may also face additional barriers seeking or accessing treatment for long COVID or financial barriers to affording treatment. For some people, long COVID results in being unable to work for an extended period of time. Support options for these situations need to be considered. In addition, long COVID is a complex condition that may not be adequately understood or recognised by the medical profession, creating further difficulties for patients seeking validation of their experience and support, worsening existing access and equity issues. Throughout this report, we will consider equity considerations, and specifically explore questions related to: What equity issues are evident in long COVID experiences and responses overseas? Are there any useful examples from overseas of how to ensure long COVID is addressed equitably? How might New Zealand experience inequities with respect to long COVID and how could these be mitigated?

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

Long COVID Evidence Update

Key Points

- No international definition has been agreed upon for ongoing symptoms following acute SARS-CoV-2 infection, however long COVID usually refers to the ongoing nature of symptoms from 4 weeks onwards.
- There are a range of signs and symptoms that have been associated with long COVID. Symptoms can be respiratory, cardiopulmonary, neurological, or generalised. They can be concurrent, fluctuating and overlapping. Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses. The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms.
- Long COVID in children is not well described, and prevalence varies widely. There is some emerging evidence that signs and symptoms or clinical presentation may differ for children, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults.
- The prevalence of long COVID is difficult to establish for a range of reasons, however preliminary studies suggest that approximately 30% of people who test positive for COVID-19 experience symptoms for 12 weeks or longer.(1)
- Evidence continues to emerge on the cause/s of long COVID. A range of factors have been suggested to contribute to long COVID, including effects of the virus on the body (particularly on the nervous system and vascular system); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19.
- Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Some factors that have been associated with an increased risk of long COVID include age, having underlying health conditions, a higher body mass index, and being female. Vaccines are important in preventing long COVID and are effective prior to infection and post-infection.
- Long COVID patients are reporting multiple psychosocial impacts, including mental health related impacts, with an impact on the ability of some patients to work.
- While the fiscal impacts of the COVID-19 pandemic in general is reasonably well known and reported on across jurisdictions, the fiscal impacts are less well known, but could include decreased productivity from a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.
- There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definition.
- Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient, and an individualised management plan developed.

- There are an increasing number of guidelines available for clinical management of patients with long COVID which are briefly presented here.

Introduction

In the early stages of the pandemic, most attention was focused on the acute health impacts of SARS-CoV-2 infection.(2) It was initially thought that although some people have a prolonged and complicated hospital stay, most people recover from 'mild' infections within two weeks and from more serious disease within three weeks.(3) However, it has become clear that for some people COVID-19 can lead to persistent illness, with ongoing and often debilitating symptoms.(3-5)

This document is a summary of the current evidence known about the long-term health impacts of COVID-19, often referred to as long COVID, and the experiences of people living with long-term complications of COVID-19. It is a collation of expert opinion and the latest scientific and technical research exploring the ongoing nature or long-term presentation of signs and symptoms that appear or continue to occur after the acute phase of COVID-19, as well as aetiology, epidemiology, issues related to the impact of vaccination and new emerging variants. Developments in international guidance from peak bodies on diagnosis, management, support and rehabilitation pathways will also be explored. It reflects current knowledge at the time of writing (May 2022). It is a live and working document which will be updated as new evidence emerges, with an updated report scheduled to be shared every six to eight weeks with the Chief Allied Health Professions Office, Ministry of Health, Aotearoa New Zealand.

Long COVID terminology and definitions

Ongoing symptoms are common following many viral and bacterial infections, including other coronaviruses. The term 'long COVID' is commonly used to describe signs and symptoms that continue or develop after acute COVID-19 (four weeks from the initial infection). Symptoms may last for weeks or months after the acute illness. The presence of lingering symptoms may have a significant impact on the daily lives of those who are affected, and their family and whānau. Given the numbers of people who have been or will be infected with SARS-CoV-2 worldwide, the public health impact of long COVID could be significant.

There is no internationally agreed definition of the long COVID condition yet. However, the WHO published the following clinical case definition (created by a Delphi consensus) in October 2021:

> "Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis.
>
> Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others which generally have an impact on everyday functioning.
>
> Symptoms may be new onset, following initial recovery from an acute COVID-19 episode, or persist from the initial illness. Symptoms may also fluctuate or relapse over time. A separate definition may be applicable for children."

The Centers for Disease Control and Prevention (CDC) in the US uses the term 'post-COVID conditions' to describe long COVID, defined as a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19.

The National Institute for Health and Care Excellence (NICE) in the UK uses the following definitions to classify the long-term effects of COVID-19:

- Ongoing symptomatic COVID-19: Signs and symptoms of COVID-19 from 4 weeks up to 12 weeks.
- Post-COVID-19 syndrome: Signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis. It usually presents with clusters of symptoms, often overlapping, which can fluctuate and change over time and can affect any system in the body.

According to this NICE definition, the term 'long COVID' captures signs and symptoms that continue or develop after acute COVID-19 and includes both ongoing symptomatic COVID19 (from 4 to 12 weeks) and post COVID-19 syndrome (12 weeks or more). NICE outline that 'post-COVID-19 syndrome' may be considered before 12 weeks while the possibility of an alternative underlying disease is also being assessed.

Across the international literature, long COVID may be referred to by many names, including long COVID, long-haul COVID, post-acute COVID-19, post-acute sequelae of SARS CoV-2 infection (PASC), long-term effects of COVID, and chronic COVID.

Symptoms and Signs

There are **a range of signs and symptoms** that have been associated with long COVID. Signs and symptoms can vary greatly, and one systematic review and meta-analysis completed in early 2021 found 55 long-term effects noted across 15 studies.(6) Symptoms can be respiratory, cardiopulmonary, neurological, or generalised, as it detailed in Table 1 below.(7)

Table 1: Commonly reported symptoms of long COVID

Cardiopulmonary • Difficulty breathing or shortness of breath • Cough • Chest pain, tightness, or heaviness [1] • Palpitations **Neurological** • Cognitive impairment ('brain fog', loss of concentration or memory issues) • Headache • Sleep disturbance • Peripheral neuropathy symptoms (pins and needles, numbness) • Ongoing changes to smell or taste • Dizziness • Delirium (in older populations) **Musculoskeletal** • Muscle aches and pains	**Generalised symptoms** • Fatigue • Fever • Pain • Reduced exercise capacity **Gastrointestinal** • Abdominal pain • Nausea • Diarrhoea • Anorexia and reduced appetite (in older populations) **Ear, nose, and throat** • Tinnitus • Earache • Sore throat • Dizziness

[1] Clinical assessment is required to investigate the specific cause

• Muscle weakness[2] • Joint pain **Psychological/ psychiatric symptoms**[3] • Symptoms of depression • Symptoms of anxiety	**Other** • Skin rashes (including vesicular, maculopapular, urticarial, or chilblain-like lesions on the extremities) • Metallic or bitter taste • Metabolic disruption (such as poor control of diabetes) • Thromboembolic conditions

Some research indicates that people experiencing long COVID tend to fall into one of two symptom groups: those experiencing ongoing respiratory symptoms (including coughing and shortness of breath), combined with fatigue and headaches; and those experiencing multi-systemic symptoms, affecting the heart, brain and gut (for example, palpitations and 'brain fog').(8)

In addition to the wide range of possible symptoms, some of the key features of long COVID include:(1, 3, 5)

- Concurrence of multisystem, fluctuating and often overlapping 'clusters' of symptoms
- Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses;
- Symptom severity may range from mild to incapacitating;
- Worsening of symptoms after physical or mental activity
- Relapses may occur in an irregular pattern or in response to specific triggers (e.g. physical or mental activity, stress, menstruation, heat, or alcohol).
- People may experience new symptoms that were not present during the acute phase of their COVID-19 infection.

The most commonly reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms. One meta-analysis concluded that the effects largely corresponded with clinical symptoms including fatigue (58%), headache (44%), attention disorder or cognitive impairment/brain fogginess (27%), hair loss (25%) and dyspnea (24%) (shortness of breath).(6)

A systematic review and meta-analysis published in mid-April 2022 found over 60 physical and psychological signs and symptoms with wide prevalence were reported across 39 studies, though notably most studies had a high or moderate risk of bias. The most reported symptoms were weakness (41%; 95% CI 25% to 59%), general malaise (33%; 95% CI 15% to 57%), fatigue (31%; 95% CI 24% to 39%), concentration impairment (26%; 95% CI 21% to 32%) and breathlessness (25%; 95% CI 18% to 34%). 37% (95% CI 18% to 60%) of patients reported reduced quality of life; 26% (10/39) of studies presented evidence of reduced pulmonary function.(9)

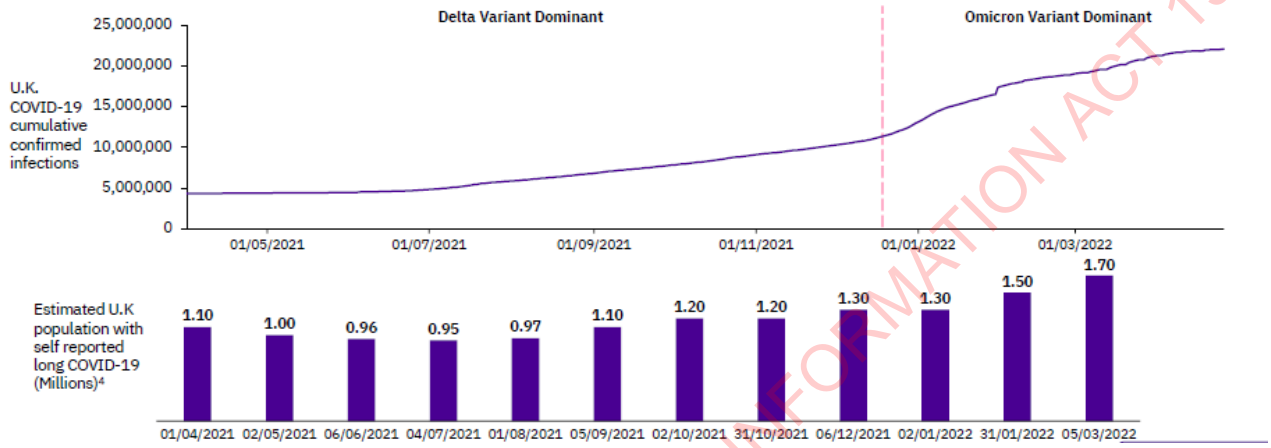
There is limited evidence on any association between how symptom presentation may differ between variants for long COVID, and this area could be confounded by a variety of factors such as the vaccination rollout, changes in treatment, as well as changes in detection and testing capacities as well as levels of community prevalence. With the high rates of community transmission of Omicron, and increased asymptomatic transmission, there is less detection of Omicron occurring, compounded by the shift to relying on rapid antigen tests. One early observational study found the Alpha variant was more likely to cause persistent cognitive symptoms when compared to the original Wuhan variant, and mental health symptoms, though these could have been influenced by a range of causes. In this same study the Alpha

[2] Muscle weakness can be a reported symptom, and may also be clinically measured
[3] The WHO has noted that the association between long COVID and psychiatric disorders is likely bidirectional

variant appeared less likely to cause impaired hearing or a loss of sense of smell compared with the original variant.(10)

Omicron

There is limited data available on Omicron, however initial evidence from the UK's ONS suggests that despite lower case severity with Omicron, these variants are still presenting a significant long COVID burden, as being driven by the higher number of cases.(link, visualisation by Airfinity)



The UK's ONS conducted a study using self-reported data from COVID-19 cases to explore the impact of Omicron BA.1 or BA.2 variants on long COVID. The data suggested

a) For boosted adults, there was no statistically significant difference in the risk of self-reported long COVID between first infections with the Delta variant and with either Omicron BA.1 or Omicron BA.2.
b) For boosted adults, the odds of reporting long COVID symptoms four to eight weeks after infection were 21.8% higher after Omicron BA.2 than Omicron BA.1.
c) For those with only a primary course of two doses, the survey found that the odds of reporting long COVID symptoms after infection were 49.7% lower in Omicron B.A1 infections than the Delta variant.

Long COVID in children

Long COVID in children is not well described, and the studies to date have generally been of poor quality, with some major limitations (such as a lack of a clear case definition, arbitrary follow up time points, subjective assessment, lack of control groups, and low response rates).(11, 12) Evidence is predominantly limited to select populations without control groups.(13) Relatively few studies have focused on SARS-CoV-2 infection sequelae in children and adolescents, and large, harmonised longitudinal studies are needed.(14) Persistent illness in children has been noted in some studies and in patient support groups, but its prevalence, characteristics and duration are unclear.(15, 16)

Estimates of the prevalence of long COVID in children vary widely.(12) The variability in prevalence estimates could be due to a range of factors, such as initial SARS-CoV-2 infection severity, different methodological approaches (clinical assessment vs self-report), definition of cases (diagnosed vs suspected), variable follow-up times, and prevalence of pre-existing clinical conditions.(13) In the US, a large long-term study of the impacts of COVID-19 on children has recently begun. It will track up to 1,000

children and young adults and evaluate the impacts on their physical and mental health over three years.[14] Some studies suggest that long COVID in children is less common and tends to be less protracted than in adults. (17)

There is some emerging evidence that signs and symptoms or **clinical presentation may differ for children**, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults. The NICE panel noted that common presentation in children is a lack of concentration, short-term memory loss, and/or difficult doing everyday tasks ≥4 weeks after acute COVID-19 illness.

Some of the studies of long COVID in children include:

- A review of studies of long COVID in children and adolescents identified 14 heterogeneous studies (4 cross-sectional, 9 prospective cohort, 1 prospective cohort) investigating long COVID symptoms in a total of 19,426 children and adolescents. The prevalence of long COVID symptoms varied from 4% to 66%, and there was also large variation in the reported frequency of different symptoms. Zimmerman et al (2021) note that all the studies in their review were likely to have been conducted before the Delta variant became dominant, which may have a different risk of long COVID.(12)
- A recent pre-print describes a German study of 157,134 individuals (11,950 children/adolescents and 145,184 adults) with confirmed COVID-19.(18) The COVID-19 and control cohorts were well-balanced regarding covariates. For all adverse health outcomes combined, incidence rates (IRs) in the COVID-19 cohort were significantly higher than those in the control cohort in both children/adolescents. Incidence rate ratio (IRR) estimates were similar for the age groups 0-11 and 12-17. Incidence rates in children/adolescents were consistently lower than those in adults. Among the specific outcomes with the highest IRR and an incidence rate of at least 1/100 person-years in the COVID-19 cohort in children and adolescents were malaise/fatigue/exhaustion, cough, and throat/chest pain.
- The UK Office of National Statistics found that 9.8% of children aged 2-11 years and 13% aged 12-16 years reported at least one ongoing symptom five weeks after a positive diagnosis, whereas 25% of adults aged 35-69-years had symptoms five weeks after a positive diagnosis.(19, 20)
- A paper describing data from the UK COVID Symptom Study (a citizen science project with data collected via an app, which has some associated limitations) found that of 1,734 children aged 5-17 years who were symptomatic at the time of their positive test and reported symptoms regularly for at least 28 days, 4.4% had an illness duration of at least 28 days.(15) Ongoing symptoms for at least 28 days was less common in younger children aged 5-11 years (3.1%, p=0.046). Over 98% of 1,379 children had recovered by 56 days.(15) However, there may be some bias as using apps is likely to select participants from higher socio-economic background, who have a lower risk of poor outcomes.(12)
- One of the earliest studies on long COVID in children (a cross-sectional study of 129 children in Italy who were diagnosed with COVID-19 between March and November 2020) reported that 42.6% of children surveyed had one or more symptoms >60 days post infection.(21) This included children with mild or asymptomatic initial infection.
- A cohort study of 136 children (most of whom had mild or asymptomatic COVID-19) in Melbourne in 2020 observed that 8% of children had post-acute symptoms. They found that full recovery occurred within weeks of acute symptom onset and reported symptoms were mild in severity but noted this was a young cohort (median age three years).(17)

Long-term SARS-CoV-2 infection–associated symptoms can be difficult to distinguish from pandemic-associated symptoms.(11, 12) Some studies have found that children who tested negative for COVID-19 have had similar symptoms, which are common after other viral infections, and could also be due to the experience of lockdown and other social restrictions.(22, 23) Given that acute COVID-19 generally poses a low risk to children, an accurate determination of the risk of long COVID is important in the debate about the risks and benefits of vaccination in this age group.(12) Similar to adults, it is likely that long COVID in children may have a greater impact on those from socioeconomically disadvantaged areas and ethnic minortity groups.(14)

In summary, "the relative scarcity of studies of long COVID and the limitations of those reported to date mean the true incidence of this syndrome in children and adolescents remains uncertain. The impact of age, disease severity and duration, virus strain, and other factors on the risk of long COVID in this age group also remains to be determined."(12) However, even if the proportion of children experiencing post-acute impacts is relatively low, if transmission is widespread (as has been with Omicron), then the impact of persisting symptoms will be considerable.

Epidemiology

Prevalence and incidence

The prevalence of long COVID is difficult to establish for a range of reasons, including:(6, 24, 25)

- Studies of long COVID have used different measurement criteria and different inclusion criteria, so they cannot be reliably compared. Studies also often differ in the way they collect data.
- Studies have focused on different groups of people, different symptoms, and time intervals, and used different sample sizes.
- Most studies report the frequency of at least one symptom (not necessarily the same symptom), rather than a cluster of symptoms.
- Published studies may not be representative of everyone who has long COVID.
- Difficulties in accessing COVID-19 testing in different countries may mask the true number of long COVID cases if studies require testing confirmation of the initial infection. In addition, testing policies vary between countries.
- The ways in which responses are elicited can impact estimated prevalence (e.g., app users are self-selected and responsible for recording symptoms, which can result in sampling and recording biases). In addition, many studies use retrospective self-reported symptoms.
- Some tools validated for other diseases may not be appropriate for use in long COVID patients.
- The prevalence of long COVID may also vary greatly depending on the groups studied (for example, app users vs population studies vs studies of patients who were hospitalised).

Despite these limitations, there is increasing evidence that a significant proportion of people experience long COVID, and there are concerns that these long term effects may occur on a scale that "could overwhelm existing health care capacity, particularly in low- and middle-income countries."(10)

Please see the below table for an overview of prevalence estimates from some key sources, systematic reviews and meta-analyses.

Paper	Population / Aim/ Number of studies	Key findings
Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 6 May 2022. The Office for National Statistics UK.	1.8 million people (self-reported)	An estimated 1.8 million people living in private households in the UK (2.8% of the population) were experiencing self-reported long COVID (symptoms persisting for more than four weeks after the first suspected coronavirus infection that were not explained by something else) as of 3 April 2022.
A systematic review and meta-analysis published in mid-April 2022(26): Chen, C., et al., *Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review.* The Journal of Infectious Diseases, 2022.	50 studies were included and 41 were part of the meta-analysis.	As of 16 April 2022, the global estimated pooled prevalence of post COVID-19 condition was 0.43 (95% CI: 0.39,0.46), or 200 million individuals. - Regional prevalence estimates were Asia— 0.51 (95% CI: 0.37,0.65), Europe— 0.44 (95% CI: 0.32,0.56), and North America— 0.31 (95% CI: 0.21,0.43). -Global prevalence for 30, 60, 90, and 120 days after infection were estimated to be 0.37 (95% CI: 0.26,0.49), 0.25 (95% CI: 0.15,0.38), 0.32 (95% CI: 0.14,0.57) and 0.49 (95% CI: 0.40,0.59), respectively. -Hospitalised and non-hospitalised patients had estimates of 0.54 (95% CI: 0.44,0.63) and 0.34 (95% CI: 0.25,0.46), respectively. - Denmark has the highest estimate of Long COVID-19 per 100,000 people (defined in this case as at least one symptom of COVID-19 up to 120 days after infection), with 23,558, followed by Andorra (23,329), and Israel (23,194). -The United States has the highest absolute number of Long COVID-19 cases, with 25,141,186, followed by India (22,824,713), and France (12,526,469).
Systematic review and meta-analysis published in August 2021 (6): Lopez-Leon, S., et al., *More than 50 long-term effects of COVID-19: a systematic review and meta-analysis.* Scientific Reports, 2021. **11**(1): p. 16144.		Estimated that the number of people with SARS-CoV-2 who developed one or more long-term symptoms could be as high as 80% of patients.
October 2021 systematic review (10): Groff, D., et al., *Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2*	The mean age was 54.4 years, and 79% were hospitalised during acute COVID-19. High-income countries	The median (IQR) proportion of COVID-19 survivors experiencing at least 1 post-acute sequelae of COVID-19 (PASC) was 54.0% (45.0%-69.0%; 13 studies) at 1 month (short-term), 55.0% (34.8%-65.5%; 38 studies) at 2 to 5 months (intermediate-term), and 54.0% (31.0%-67.0%; 9 studies) at 6 or more months (long-term).

Infection: A Systematic Review. JAMA Network Open, 2021. **4**(10): p. e2128568-e2128568.	contributed 79% of the studies.	That is, more than half of COVID-19 survivors experienced PASC 6 months after recovery.
Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ (2021) Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLoS Med 18(9): e1003773. (27)	A retrospective cohort study based on linked electronic health records (EHRs) data from 81 million patients including 273,618 COVID-19 survivors.	Among COVID-19 survivors (mean [SD] age: 46.3 [19.8], 55.6% female), 57.00% had one or more long-COVID feature recorded during the whole 6-month period (i.e., including the acute phase), and 36.55% between 3 and 6 months. Findings showed that the highest prevalence is in Asia, followed by Europe and North America. The data is limited due to being self-reported with the studies definitions of long COVID varying from 4 to 12 weeks. .

Aetiology

Long COVID is complex and there is likely to be more than one mechanism that contributes to its development. Evidence continues to emerge on the molecular contributors to long COVID, which may inform advice for management and treatment.

A range of factors have been suggested to contribute to the development of long COVID, including effects of the virus on the body (particularly on the nervous system and vascular system); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19. The current four main theories suggest possible causes may be: (link)

1) persistent virus or viral antigens causing chronic inflammation
2) autoimmunity triggered by infection
3) dysbiosis and viral reactivation
4) unrepaired tissue damage

More research is needed to better understand the potential immunological mechanisms contributing to the development of long COVID. Some people with long COVID are experiencing similar symptoms to myalgic encephalomyelitis / chronic fatigue syndrome (ME/CFS) and other post-viral infections. There is research underway to investigate how long COVID may be related to these conditions.

Risk Factors

There is a growing body of evidence on which groups are at greatest risk of developing persistent symptoms.

Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Even people who initially had no symptoms may go on to develop long COVID.(28) Long COVID is seen in all age groups. However, it appears to be less common in children and adolescents than in adults.

Some factors that may be associated with increased chance of having long COVID symptoms have been identified, and these include:

- older age (4, 8, 29) (link)
- having more than one underlying chronic medical condition or pre-existing conditions
- a higher body mass index (obesity) (29)
- being female (29, 30)(link)
- hospitalisation during acute COVID 19 (31)
- multiple early symptoms (32, 33)

In the UK's Coronavirus (COVID-19) Infection Survey, prevalence of self-reported long COVID was greatest in people aged 35 to 49 years, females, people living in more deprived areas, those working in social care, teaching and education or health care, and those with another activity-limiting health condition or disability. Notably, this was self-reported rather than from clinical diagnosis.(link)

Other factors that immunologically may predispose people to a greater risk of long COVID have been noted,(32) and these include having a greater viral load during early stages of infection, the presence of autoantibodies,(34) imbalances or compositional alterations in gut microbiome,(34, 35) and vaccination status.(36) Previous Epstein-Barr infection or a reactivation of latest viruses during initial infection has also been noted.(34, 37)

Prevention

Vaccination

The impact of vaccination prior to infection on long COVID

The UKHSA conducted a rapid evidence briefing in January 2022 which investigated the effectiveness of vaccination against long COVID.(38) This briefing collated evidence from eight studies which investigated the effectiveness of vaccination against long COVID prior to infection. Most evidence suggested full vaccination (a primary course) made participants less likely to develop long COVID symptoms after infection. This was seen in short (4 weeks), medium (12-20 weeks) and long (6 months) term timeframes after infection. In two of the eight studies, participants that were fully vaccinated were less likely to report the following symptoms in the medium to long term: fatigue, persistent muscle pain, headache, hair loss, weakness in arms and legs, shortness of breath, dizziness, anosmia, interstitial lung disease, myalgia and other pain.(38) All participants in these studies had experienced COVID-19 infections, and therefore an underestimation of the effectiveness of vaccinations in preventing long COVID is likely, as the studies did not measure cases where vaccination contributed to preventing infections altogether.

One study found that people that were fully vaccinated (defined as a primary course) prior to infection had approximately half the chance of developing symptoms that lasted longer than 28 days than people that had not been vaccinated, suggesting **a benefit in preventing long COVID**.(36) The United Kingdom's Office for National Statistics showed similar data, suggesting a 41.1% lower risk of long COVID symptoms after 12 weeks in people with at least two doses of COVID-19 vaccine when compared to people of relative socio-demographic but not fully vaccinated.

There is no data in children about the level of protection provided by vaccination against the incidence of long COVID (in addition to that from protection against infection) in those who have become infected after vaccination.

The impact of vaccination after infection on long COVID

It is recommended that after a COVID-19 infection, people should start or continue their vaccination after 3 months from recovery.

The UKHSA rapid evidence briefing also reported on 3 studies which compared people with long COVID who were infected with COVID-19 then subsequently vaccinated to participants that remained unvaccinated following infection. All three studies reported that **the cohort who received the vaccinations were significantly less likely to experience long COVID symptoms shortly after vaccination and over longer periods**.(38)

A community-based cohort study of 28,356 participants (mean age 46 years, 56% female, 89% white) from the UK's COVID-19 Infection Survey examined the trajectory of long COVID symptoms following COVID-19 vaccination. Participants were aged 18 to 69 years who received at least their first vaccination after test-confirmed infection. The study had a median follow-up of 141 days from first vaccination (among all participants) and 67 days from second vaccination (84% of participants). First vaccination was associated with an initial 12.8% decrease (95%CI: −18.6% to −6.6%) in the odds of long COVID, but increasing by 0.3% (−0.6% to +1.2%) per week after the first dose. Second vaccination was associated with an 8.8% decrease (−14.1% to −3.1%) in the odds of long COVID, with the odds subsequently decreasing by 0.8% (−1.2% to −0.4%) per week. There was no statistical evidence of heterogeneity in associations between vaccination and long COVID by socio-demographic characteristics, health status, whether hospitalised with acute COVID-19, vaccine type (adenovirus vector or mRNA), or duration from infection to vaccination.(39)

As part of a federated research study with the COVID-19 Patient Recovery Alliance, Arcadia Data Research (Arcadia.io) performed a retrospective analysis of the medical history of 240,648 COVID-19-infected persons to identity factors influencing the development and progression of long COVID. Data were captured directly from electronic health record (EHR) systems, practice management systems. This analysis revealed that patients who received at least one dose of any of the three COVID vaccines available in the US (Pfizer, Modern or Janssen) prior to their diagnosis with COVID-19 were 7-10 times less likely to report two or more long-COVID symptoms compared to unvaccinated patients. Furthermore, unvaccinated patients who received their first COVID-19 vaccination within four weeks of SARS-CoV-2 infection were 4-6 times less likely to report multiple long-COVID symptoms, and those who received their first dose 4-8 weeks after diagnosis were 3 times less likely to report multiple long COVID symptoms compared to those who remained unvaccinated. The study authors argue that this relationship supports the hypothesis that **COVID-19 vaccination is protective against long COVID and that effect persists even if vaccination occurs up to 12 weeks after COVID-19 diagnosis**.(40)

Additionally, one study assessed the timing of vaccination following COVID diagnosis and concluded that people who were vaccinated sooner were likely to report less long COVID symptoms than unvaccinated people. However, in both vaccinated and unvaccinated people following infection, most people (up to 70%) reported no change to long COVID symptoms after vaccination.(41) The study population were limited to 44 vaccinated patients with 22 matched unvaccinated patients, and therefore larger studies are needed.

A study in the UK surveyed 900 people living with long COVID and evaluated the impact of their first COVID-19 vaccination on their symptoms. In this 57.9% of people reported an improvement to symptoms, 24.2%

no change and 17.9% reported deterioration. The report also stated that people who received mRNA vaccines tended to report larger levels of improvement compared to adenovector vaccines. This is the largest survey to date of people living with long COVID, however due to the self-reporting nature of the survey, it is noted that a randomised controlled trial would be required confirm any direct links between that it observed between vaccination and improvement to long COVID symptoms.(42)

Impacts

Psychosocial impacts

The functional impairment experienced by some people with long COVID and the toll managing symptoms has on quality of life is becoming clearer. An early patient-led study of 3,762 self-described long haulers in 56 countries found 45.2% (42.9% to 47.2%) reported requiring a reduced work schedule compared to pre-illness and 22.3% (20.5% to 24.3%) were not working at the time of the survey due to their health conditions.(43).

Long COVID patients are **reporting multiple psychosocial impacts, including mental health related impacts**. This includes reporting experiences of feeling depressed, anxious, or worried.(44) (44)Another article considering guidance to support patients experiencing long COVID found several specific mental health challenges, including: post-traumatic stress disorder (PTSD), major depressive disorder, anxiety disorders, sleep disorders, phobias, fears with avoidant behaviours, health anxieties, obsessive-compulsive disorder (OCD) and adjustment disorder related to living with long COVID-19 symptoms, social exclusion and addictions (as a form of coping), and neuropsychiatric disorders.(45)

Additionally, **long COVID has had an impact on the ability of some patients to work.** People with ongoing symptomatic COVID-19 or post-COVID-19 syndrome who report increased absence or reduced performance in education or work may need extra support and recovery time.(46) Long COVID therefore limits the ability of people to return to work and to socialise, not only potentially further affecting their mental health, but also having economic consequences for them, their whānau and society.(5)

Overall, long COVID is having an impact on reported quality of life. An online survey study completed in 2021 found an overall reduction in quality of life, and this was due to a range of the symptoms reported which included sleep quality, breathlessness, physical activity and mental health.(44)

Social and economic impacts

While the fiscal impacts of the COVID-19 pandemic in general is well known and reported on across jurisdictions, **the fiscal impacts of long COVID specifically are less well known and scarcely reported on, as the impacts are hard to quantify given the wide variety of variables involved**. The impact of long COVID can be looked at from multiple angles, from **decreased productivity from a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.**

The Solve Long COVID initiative, a non-profit research and advocacy group in the United States has estimated that the disability caused by long COVID has cost $386 billion dollars in the United States alone, when considering only the personal financial impact on affected individuals, like lost wages, lost savings, and healthcare costs, from the beginning of the pandemic through to January 31 2022.(link)

Further work to measure the financial impact of long COVID is still required to fully understand its scale. Countries across the globe have committed varying levels of financial resources to diagnose, understand

and treat the condition, but research and reporting regarding the overall financial impact and the second and third order financial effects of long COVID is currently scarce.

The social and economic burden of long COVID will affect Māori and Pacific peoples to a greater degree, as they have accounted for a greater proportion of cases during Aotearoa New Zealand's Delta and Omicron outbreaks.

Treatment and Support

Diagnosis

There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definitions of long COVID (as is detailed above).

Although there are a wide range of symptoms that can present for long COVID, many of these symptoms are common from a multitude of other conditions, making them hard to decipher or confirm as long COVID. Additionally, ongoing symptoms may vary widely and will affect people in diverse ways, and symptoms can be diverse with multiorgan involvement. Long COVID is multi-factorial, and more than one mechanism may be implicated in clinical presentations.(47)

Compounding the lack of clear definitions, due to the relative newness of the condition, there may be a limited amount of knowledge of the condition known by many health care professionals.

There is currently no specific tests to aid in the diagnosis.

Models of care

Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient,(5) and an individualised management plan developed.(48) Some patients may find it useful to keep track of their symptoms. Keeping a log of symptoms can help better understand them, identify which symptoms impact them most, and identify patterns and changes in their symptoms.(49)

Internationally, multidisciplinary teams are working together to tackle the unique symptoms each patient experiences and tailoring treatment to them.(3) Countries are creating dedicated treatment guidelines and care pathways, and the US, UK and Germany have opened post-COVID clinics as one-stop-shops for treatment and support. For example, an Adult Post-Acute COVID clinic at Vanderbilt University brings together specialists from internal medicine, infectious disease, pulmonology, cardiology, ophthalmology, psychology, physical medicine, ear, nose and throat, speech pathology and neurology.(3) Physical therapy, physiotherapy, and occupational therapy have also been key tools used for those struggling with fatigue. Nutritional support has also been important, with lethargy having flow-on effects onto the ability to cook and prepare food, resulting in some struggling with malnutrition.(50)

Specific symptom management will usually be pragmatic, with avoidance of over-investigation.(48, 51)

For Aotearoa New Zealand, an equity focus with a co-design approach with key affected communities of those living with long COVID, Māori and Pacific peoples is key. Patient and peer support networks have played a key role in the initial response to long COVID.

International guidelines on rehabilitation and management

Existing international guidelines propose that the initial management of long COVID should be in primary care and should include a series of investigations both to characterise how the individual is affected and to exclude other conditions that may coexist. Management, referrals and care pathways should then be tailored to the manifestations of disease, including investigation and referral for signs of involvement of different organ systems (5). The patient voice has been critical in shaping awareness of long COVID internationally and within New Zealand, and patient- and whānau-centred care should continue to be the focus.

Alongside treatment options, support and care services may be needed for people with persistent symptoms. Counselling and psychological support may be needed to address high rates of poor mental health, and many of the post-COVID clinics set up throughout the US and UK contain psychology services or referrals.(52)

There are an increasing number of guidelines available for clinical management of patients with long COVID. Some of these are listed below. These might be useful to consult when developing New Zealand specific guidelines.

Source	Title	Date	Link	Notes
Australian National COVID-19 Clinical Evidence	Australian Guidelines for the clinical care of people with COVID-19: Post COVID-19	Living Guidelineslast updated 9 May 2022	https://app.magicapp.org/#/guideline/L4Q5An/section/jDJJJQ	Guidance for clinicians on: - Assessing and diagnosing post-COVID conditions - A consensus recommendation of symptoms and signs - Management and care of people with post-COVID-19 condition
National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and Royal College of General Practitioners (RCGP)	COVID-19 rapid guideline: managing the longterm effects of COVID-19	Version 1.14 published on 01.03.2022	https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-510355157422	Guidance for clinicians on: - Identification - Assessment - Investigations and referral - Planning care - Management (including self-management or supported management, multidisciplinary rehabilitation, and additional support) - Follow-up, monitoring and discharge - Sharing information and continuity of care - Service organisation - Common symptoms - Equality considerations
Centres for Disease Control and Prevention (CDC), USA	Interim Guidance on Evaluating and Caring for Patients with Post-	June 2021	https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-	Includes guidance on general clinical considerations, patient history and physical examinations, assessment and testing, management and public health recommendations. The guidelines argue many post-COVID conditions can be managed by primary care providers, with the incorporation of patient-centered approaches to optimise the quality of life and function in affected patients.

	COVID Conditions		covid-index.html	Objective laboratory or imaging findings should not be used as the only measure or assessment of a patient's well-being; lack of laboratory or imaging abnormalities does not invalidate the existence, severity, or importance of a patient's symptoms or conditions. Healthcare professionals and patients are encouraged to set achievable goals through shared decision-making and to approach treatment by focusing on specific symptoms (e.g., headache) or conditions (e.g., dysautonomia); a comprehensive management plan focusing on improving physical, mental, and social wellbeing may be helpful for some patients.
BMJ Practice Pointer (51)	Management of post-acute COVID-19 in primary care	Aug 2020	https://www.bmj.com/content/370/bmj.m3026	Guidance for the management of people with long COVID in primary care.
The Royal Australian College of General Practitioners (48)	Caring for adult patients with postCOVID-19 conditions.	Oct 2020	https://www.racgp.org.au/FSDEDEV/media/documents/RACGP/Coronavirus/Post-COVID-19-conditions.pdf	This document aims to support general practice to collaborate with local hospital services in the care of patients with these conditions.
Scottish Intercollegiate Guidelines Network (SIGN) (53)	Managing the long-term effects of COVID-19	Dec 2020	https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf	This document covers care for people who have symptoms that develop during or after an infection consistent with COVID-19, continue for more than four weeks and are not explained by an alternative diagnosis. It also provides advice on diagnosis and management based both on the best available evidence and the knowledge and experience of the expert panel.
Ontario Health	Post-COVID-19 Condition: Guidance for Primary Care	Dec 2021	https://www.ontariohealth.ca/sites/ontariohealth/files/2021-12/PostCovidConditionsClinicalGuidance_EN.pdf	This document includes guidance for primary care on: - Assessment - Testing - Diagnosis - Physical examination - Management
Chartered Society of Physiotherapy	COVID-19 Rehabilitation Standards	August 2021	https://www.csp.org.uk/publications/covid-19-community-rehabilitatio	UK guidance for physiotherapy service delivery for adults who are hospitalised due to acute COVID-19 or long COVID

			n-physiotherapy-service-delivery	

Policy Responses

The full magnitude of the long COVID burden globally is still yet to be known, with countries all at varying stages of their response to COVID-19, with some only having experienced significant outbreaks following the emergence of the Omicron variant, resulting in a lack of first-hand experience in addressing long COVID and undeveloped systems to respond to and report on long COVID.

In order for an equitable policy response in Aotearoa New Zealand, partnership and shared decision-making with key affected communities, including those with long COVID, the Māori Health Authority, the Ministry for Pacific Peoples, and the New Ministry for Disabled People.

United Kingdom: The UK government has set up over 80 specialist clinics[i] to provide support to those suffering from long COVID, which provide psychological and physiological support services. Further research funding is being provided through grants to NGOs and healthcare providers through the National institute of health, to date only around 50 million pounds of funding has been provided for research in to Long COVID.[ii] The UK government has made Statutory Sick Payments, Universal Credit or Employment and Support Allowance (ESA) available to people if Long COVID affects how much they can work. Affected individuals can also apply for a Personal Independence Payment if they have difficulty with everyday tasks and getting around.[iii] The UK's response has endeavoured to provide all information in accessible and age-appropriate formats so that people can understand and take part in decisions about their care, as guided by the NICE guidelines on shared decision making and good patient experiences.

United States: As of July 2021, long COVID, also known as post-COVID conditions, can be considered a disability under the Americans with Disabilities Act.[iv] President Joe Biden has directed federal agencies to support patients and doctors by providing science-based best practices for treating long COVID, maintaining access to insurance coverage, and protecting the rights of workers as they try to return to jobs while coping with the uncertainties of the malaise.[v]

France: Since the French government identified Long COVID at the end of the first wave of the virus in spring 2020, it has been watching the issue closely in order to care for those affected and to better understand the disease. On 17 March 2022, the Health Minister published a statement recognising Long COVID as a health concern in France and acknowledging the necessity for ongoing research into its prevalence, diagnosis, and treatment.[vi]

Germany: The German Government has committed to the establishment of a Germany-wide network of 2,580 competence centres and interdisciplinary outpatient clinics to further research and ensure needs-based care around the long-term effects of COVID-19. German physicians dealing with Long COVID have established a dedicated national association, with thirteen specialised working groups, to promote research, share information and improve the treatment of patients suffering from Long COVID.

Sweden: The Swedish government has implemented a number of responses to Long COVID. It has supported research on COVID-19 through funding to the Swedish Research Council and tasked the Swedish Agency for Health and Care Services Analysis with mapping Long COVID care across the country. The National Board of Health and Welfare has produced guidelines and statistical reports to support the health

and welfare system in meeting the needs of Long COVID sufferers. However, the general lack of information about the condition, and awareness of it, as well as the immense pressure on the healthcare system during the pandemic, means that a system for testing and assessment, treatment, and support available to sufferers is not yet fully functioning.[vii]

Next Steps	Share with CAPHO
In the development of this work, the following parties have been consulted with:	

Resources used:		
Ministry of Health Policies and Procedures	☒ Yes ☐ No	
External Health Scientific organisations	☐ Yes ☐ No	
Existing database of RFAs	☒ Yes ☐ No	
Internal Ministry of Health Advice	☒ Yes ☐ No	
External Expert Advice	☐ Yes ☐ No	
Literature Review	☒ Yes ☐ No	

1. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188] 2021 [updated 11 November 2021. Available from: https://www.nice.org.uk/guidance/ng188.
2. Leung TYM, Chan AYL, Chan EW, Chan VKY, Chui CSL, Cowling BJ, et al. Short- and potential long-term adverse health outcomes of COVID-19: a rapid review. Emerg Microbes Infect. 2020;9(1):2190-9.

3. National Institute for Health Research. Living with COVID19 2020 [updated 15 October 2020. Available from: https://evidence.nihr.ac.uk/themedreview/living-with-covid19/#Conclusions
4. The Royal Society. Long Covid: what is it, and what is needed? 2020 [updated 23 October 2020. Available from: https://royalsociety.org/-/media/policy/projects/set-c/set-c-long-covid.pdf
5. World Health Organization (WHO). Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID Copenhagen, Denmark: WHO,; 2021 [Available from: https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf.
6. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, et al. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. Scientific Reports. 2021;11(1):16144.
7. Cau R, Faa G, Nardi V, Balestrieri A, Puig J, Suri JS, et al. Long-COVID diagnosis: From diagnostic to advanced AI-driven models. European Journal of Radiology. 2022;148:110164.
8. COVID Symptom Study. Long COVID: What do we know so far? 2021 [updated 12 April 2021. Available from: https://covid.joinzoe.com/post/long-covid-what-we-know.
9. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. BMJ Global Health. 2021;6(9):e005427.
10. Groff D, Sun A, Ssentongo AE, Ba DM, Parsons N, Poudel GR, et al. Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review. JAMA Network Open. 2021;4(10):e2128568-e.
11. Murdoch Children's Research Institute (MCRI). Research Brief: COVID-19 and Child and Adolescent Health Victoria, Australia: MCRI,; 2021 [updated 13 September 2021. Version 1:[Available from: https://www.mcri.edu.au/sites/default/files/media/documents/covid-19-and-child-and-adolescent-health-140921.pdf.
12. Zimmermann P, Pittet LF, Curtis N. How Common is Long COVID in Children and Adolescents? The Pediatric Infectious Disease Journal. 2021;40(12).
13. Radtke T, Ulyte A, Puhan MA, Kriemler S. Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents. JAMA. 2021;326(9):869-71.
14. Munblit D, Sigfrid L, Warner JO. Setting Priorities to Address Research Gaps in Long-term COVID-19 Outcomes in Children. JAMA Pediatrics. 2021;175(11):1095-6.
15. Molteni E, Sudre CH, Canas LS, Bhopal SS, Hughes RC, Antonelli M, et al. Illness duration and symptom profile in symptomatic UK school-aged children tested for SARS-CoV-2. The Lancet Child & Adolescent Health. 2021:708-18.
16. Sigfrid L, Drake TM, Pauley E, Jesudason EC, Olliaro P, Lim WS, et al. Long Covid in adults discharged from UK hospitals after Covid-19: A prospective, multicentre cohort study using the ISARIC WHO Clinical Characterisation Protocol 2021 [2021.03.18.21253888]. Available from: http://medrxiv.org/content/early/2021/03/23/2021.03.18.21253888.abstract.
17. Say D, Crawford N, McNab S, Wurzel D, Steer A, Tosif S. Post-acute COVID-19 outcomes in children with mild and asymptomatic disease. The Lancet Child & Adolescent Health. 2021;5(6):e22-e3.
18. Roessler M, Tesch F, Batram M, Jacob J, Loser F, Weidinger O, et al. Post COVID-19 in children, adolescents, and adults: results of a matched cohort study including more than 150,000 individuals with COVID-19 2021 [2021.10.21.21265133]. Available from: http://medrxiv.org/content/early/2021/10/22/2021.10.21.21265133.abstract.
19. Office for National Statistics UK. Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK 2021 [Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/alldatarelatingtoprevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk.
20. Lewis D. Long COVID and kids: scientists race to find answers: Nature; 2021 [updated 18 November 2021. Available from: https://www.nature.com/articles/d41586-021-01935-7?utm_source=twt_nat&utm_medium=social&utm_campaign=nature.
21. Buonsenso D, Munblit D, De Rose C, Sinatti D, Ricchiuto A, Carfi A, et al. Preliminary evidence on long COVID in children. Acta Paediatrica. 2021.

22. Jason LA, Katz BZ, Shiraishi Y, Mears CJ, Im Y, Taylor R. Predictors of Post-Infectious Chronic Fatigue Syndrome in Adolescents. Health Psychol Behav Med. 2014;2(1):41-51.
23. Katz BZ, Shiraishi Y, Mears CJ, Binns HJ, Taylor R. Chronic fatigue syndrome after infectious mononucleosis in adolescents. Pediatrics. 2009;124(1):189-93.
24. Martin C, Luteijn M, Letton W, Robertson J, McDonald S. A model framework for projecting the prevalence and impact of Long-COVID in the UK. PloS one. 2021;16(12):e0260843-e.
25. Ministry of Health NZ. Long COVID 2021 [updated 21 June 2021. Available from: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.
26. Chen C, Haupert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review. The Journal of Infectious Diseases. 2022.
27. Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ. Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLOS Medicine. 2021;18(9):e1003773.
28. Centers for Disease Control and Prevention (CDC). Post-COVID Conditions: Overview 2021 [updated 9 July 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Fclinical-care%2Flate-sequelae.html.
29. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Risk factors for long COVID: analyses of 10 longitudinal studies and electronic health records in the UK. medRxiv. 2021:2021.06.24.21259277.
30. Stewart S, Newson L, Briggs TA, Grammatopoulos D, Young L, Gill P. Long COVID risk - a signal to address sex hormones and women's health. The Lancet Regional Health – Europe. 2021;11.
31. Ziyad Al-Aly BB, Yan Xie et al. Long Covid after Breakthrough COVID-19: the post-acute sequelae of breakthrough COVID-19. PREPRINT (Version 1) available at Research Square [https://doiorg/1021203/rs3rs-1062160/v1]. 2021.
32. Cervia C, Zurbuchen Y, Taeschler P, Ballouz T, Menges D, Hasler S, et al. Immunoglobulin signature predicts risk of post-acute COVID-19 syndrome. Nat Commun. 2022;13(1):446.
33. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, et al. Attributes and predictors of long COVID. Nature Medicine. 2021;27(4):626-31.
34. Su Y, Yuan D, Chen DG, Ng RH, Wang K, Choi J, et al. Multiple early factors anticipate post-acute COVID-19 sequelae. Cell. 2022;185(5):881-95.e20.
35. Liu Q, Mak JWY, Su Q, Yeoh YK, Lui GC-Y, Ng SSS, et al. Gut microbiota dynamics in a prospective cohort of patients with post-acute COVID-19 syndrome. Gut. 2022;71(3):544.
36. Antonelli M, Penfold RS, Merino J, Sudre CH, Molteni E, Berry S, et al. Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study. The Lancet Infectious Diseases. 2022;22(1):43-55.
37. Gold JE, Okyay RA, Licht WE, Hurley DJ. Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation. Pathogens. 2021;10(6):763.
38. UK Health Security Agency. The effectiveness of vaccination against long COVID. A rapid evidence briefing 2022 [Available from: https://ukhsa.koha-ptfs.co.uk/cgi-bin/koha/opac-retrieve-file.pl?id=fe4f10cd3cd509fe045ad4f72ae0dfff.
39. Ayoubkhani D, Bermingham C, Pouwels KB, Glickman M, Nafilyan V, Zaccardi F, et al. Changes in the trajectory of Long Covid symptoms following COVID-19 vaccination: community-based cohort study. medRxiv. 2021:2021.12.09.21267516.
40. Simon MA, Luginbuhl RD, Parker R. Reduced Incidence of Long-COVID Symptoms Related to Administration of COVID-19 Vaccines Both Before COVID-19 Diagnosis and Up to 12 Weeks After. medRxiv. 2021:2021.11.17.21263608.

41. Arnold DT, Milne A, Samms E, Stadon L, Maskell NA, Hamilton FW. Are vaccines safe in patients with Long COVID? A prospective observational study 2021 [2021.03.11.21253225]. Available from: http://medrxiv.org/content/early/2021/03/14/2021.03.11.21253225.1.abstract.

42. Strain WD, Sherwood O, Banerjee A, Van der Togt V, Hishmeh L, Rossman J. The Impact of COVID Vaccination on Symptoms of Long COVID: An International Survey of People with Lived Experience of Long COVID. Vaccines. 2022;10(5):652.

43. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing Long COVID in an International Cohort: 7 Months of Symptoms and Their Impact 2021 [2020.12.24.20248802]. Available from: http://medrxiv.org/content/early/2021/04/05/2020.12.24.20248802.abstract.

44. Faghy MA, Maden-Wilkinson T, Arena R, Copeland RJ, Owen R, Hodgkins H, et al. COVID-19 patients require multi-disciplinary rehabilitation approaches to address persisting symptom profiles and restore pre-COVID quality of life. Expert Review of Respiratory Medicine. 2022:1-6.

45. Hussain FA. Facilitating care: a biopsychosocial perspective on long COVID. British Journal of General Practice. 2022;72(714):30-1.

46. NICE SaR. COVID-19 rapid guideline: managing the longterm effects of COVID-19. 2021 Contract No.: 16.5.22.

47. Maltezou HC, Pavli A, Tsakris A. Post-COVID Syndrome: An Insight on Its Pathogenesis. Vaccines (Basel). 2021;9(5).

48. RACGP. Caring for adult patients with post-COVID-19 conditions East Melbourne, VIC2020 [

49. The National Institute for Health Innovation. Long COVID 2021 [Available from: https://www.nihi.auckland.ac.nz/long-covid.

50. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, et al. Post-acute COVID-19 syndrome. Nature Medicine. 2021;27(4):601-15.

51. Greenhalgh T, Knight M, A'Court C, Buxton M, Husain L. Management of post-acute covid-19 in primary care. BMJ. 2020;370:m3026.

52. Walter K. An Inside Look at a Post–COVID-19 Clinic. JAMA. 2021.

53. Scottish Intercollegiate Guidelines Network. SIGN 161: Managing the long-term effects of COVID-19: National guidance for identification, assessment and management Edinburgh: SIGN; 2020 [updated 18 December 2020. Available from: https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf.

[i] British Medical Journal – COVID-19 How Europe is approaching long COVID - https://www.bmj.com/content/376/bmj.o158 - Accessed 13 May 2022

[ii] The Guardian - I have long Covid and despair that the UK government ignores its blight - https://www.theguardian.com/commentisfree/2022/apr/03/i-have-long-covid-despair-that-government-ignores-its-blight - Accessed 13 May 2022

[iii] UK Government - Find help and support if you have long COVID - https://www.gov.uk/guidance/find-help-and-support-if-you-have-long-covid#if-you-have-long-covid-and-are-unable-to-work – Accessed 13 May 2022

[iv] US CDC – Long COVID or Post COVID Conditions - https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/ - Accessed 10 May 2022

[v] https://www.pbs.org/newshour/health/biden-orders-research-push-on-long-covid-a-still-mysterious-condition - Accessed 13 May 2022

[vi] FORMAL MESSAGE: COVID-19: REQUEST FOR REPORTING – LONG COVID- FRENCH RESPONSE Unclassified – 03 May 2022

[vii] FORMAL MESSAGE: COVID-19: REQUEST FOR REPORTING – LONG COVID: SWEDEN Unclassified – 04 May 2022

Document 5

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

This form contains the details relevant to the questions posed to the Science and Technical Advisory (STA). STA will respond to the request using this form which will also be stored in STA content management system for future reference.

This form, or parts of it, may also be forwarded to other relevant parties as appropriate.

Title	Long COVID Evidence Update		
Subject	Underlying science and long-term health impacts of COVID-19		
Reference No.	501	Date Received	3/02/2022
Requestor	Martin Chadwick, Chief Allied Health Professions Officer from the Ministry of Health.	Date Due	20/05/2022
Advisor	Eloise Williams, Senior Advisor Sarah Mitchell, Senior Advisor Fiona Stephens, Senior Advisor Brooke Hollingshead, Team Leader	Date Completed	20/05/2022
Peer reviewed by	Dan Bernal, Manager, Science & Technical Advisory		
Advice issued to	Martin Chadwick, Chief Allied Health Professions Officer		
Approved by	Dan Bernal, Manager, Science & Technical Advisory		
Deliverables	A review of the evidence and health impacts on long-term effects of COVID-19		

Request Outline

Background/Context

In developing a work programme for long COVID, CAPHO have requested a regular update on what is known about the science and evidence on long COVID, and awareness of what other countries are establishing to support people with this condition.

Questions

Long COVID terminology and definitions	• What are the various terms used to describe ongoing health effects following the acute COVID-19 illness? • What are the clinical case definitions used by various organisations/ countries?
Diagnosis	• What are the limitations or challenges in making a diagnosis of long COVID? • Are there any tests available to assist with diagnosing the condition? (e.g., immune function tests)

Symptoms and signs	• Outline the range of symptoms and signs that have been associated with long COVID • Which symptoms are most common? • Disease course - pattern and severity of symptoms • Is there any association between particular variants and the types of long COVID symptoms?
Psychosocial impacts	• What kinds of mental health impacts are long COVID patients experiencing? • What impact can long COVID have on ability to work? • How does long COVID impact on quality of life overall?
Prevalence/ incidence	• What is the estimated prevalence of long COVID in various groups, including by: age (including children), ethnicity (including Indigenous), remote/rural geography, social and economic status, gender, severity of initial infection, hospitalised vs non-hospitalised, and at various timeframes after the acute illness?
	• What is the estimated prevalence of long COVID in key countries, according to sources in country? Which demographics have been most impacted by long COVID (e.g. in terms of gender, age, and ethnicity)? Key countries could include: Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain.
Aetiology	• What are the proposed mechanisms which contribute to the development of long COVID?
Risk factors	• What are the risk factors for developing long COVID?
Treatment and support	• Are there established treatments and supports known to help patients with long COVID? • What are the other treatments being investigated for long COVID patients? • What models of care are other countries putting in place/ exploring? • What guidelines do other countries/ organisations have in place for rehabilitation of patients with long COVID?

Prevention (see also, vaccination)	• Aside from vaccination, are there any other ways to reduce the risk of developing long COVID once infected with SARS-CoV-2? (e.g. importance of rest during acute illness)
Vaccination	• Does vaccination before infection reduce the symptoms or incidence of long COVID? • Does previous vaccination affect severity of symptoms in people with long COVID? • Is it considered safe for patients with long COVID to receive COVID-19 vaccines? • Does vaccination of patients with existing long COVID affect their symptoms/ disease course?
Social and economic impact	• What are the current and projected economic impacts of long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain, according to sources in country? *(Including workforce impacts such as sick days/absences, financial costs to employers, impacts on particular sectors).*
Policy responses	• How have governments responded to long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden and Spain, according to sources in country? • Has the government classed long COVID as a disability? • What social support schemes are available for people with long COVID? • What are government recommendations to employers around how to manage employees with long COVID? • What are the current treatment pathways available for those facing long COVID and what barriers are people facing in accessing these pathways?

Intended application of advice

To inform development of support packages and rehabilitation pathways for people with long COVID

Timeline

First evidence update to be sent on Friday 20 May 2022

	Ongoing updates to be provided every six to eight weeks
What are the implications and considerations of this advice on Te Tiriti o Waitangi and equity?	COVID-19 has disproportionately affected vulnerable populations and exacerbated existing inequities, and the burden of long COVID is likely to continue this trend. In New Zealand, Māori and Pacific peoples make up an increasing proportion of COVID-19 cases, so it is possible that long COVID may have a particularly high burden in these populations who already face a range of challenges. They may also face additional barriers seeking or accessing treatment for long COVID or financial barriers to affording treatment. For some people, long COVID results in being unable to work for an extended period of time. Support options for these situations need to be considered. In addition, long COVID is a complex condition that may not be adequately understood or recognised by the medical profession, creating further difficulties for patients seeking validation of their experience and support, worsening existing access and equity issues. Throughout this report, we will consider equity considerations, and specifically explore questions related to: What equity issues are evident in long COVID experiences and responses overseas? Are there any useful examples from overseas of how to ensure long COVID is addressed equitably? How might New Zealand experience inequities with respect to long COVID and how could these be mitigated?

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

Long COVID Evidence Update

Key Points

- No international definition has been agreed upon for ongoing symptoms following acute SARS-CoV-2 infection, however long COVID usually refers to the ongoing nature of symptoms from 4 weeks onwards.
- There are a range of signs and symptoms that have been associated with long COVID. Symptoms can be respiratory, cardiopulmonary, neurological, or generalised. They can be concurrent, fluctuating and overlapping. Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses. The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms.
- Long COVID in children is not well described, and prevalence varies widely. There is some emerging evidence that signs and symptoms or clinical presentation may differ for children, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults.
- The prevalence of long COVID is difficult to establish for a range of reasons, however preliminary studies suggest that approximately 30% of people who test positive for COVID-19 experience symptoms for 12 weeks or longer.(1)
- Evidence continues to emerge on the cause/s of long COVID. A range of factors have been suggested to contribute to long COVID, including effects of the virus on the body (particularly on the nervous system and vascular system); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19.
- Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Some factors that have been associated with an increased risk of long COVID include age, having underlying health conditions, a higher body mass index, and being female. Vaccines are important in preventing long COVID and are effective prior to infection and post-infection.
- Long COVID patients are reporting multiple psychosocial impacts, including mental health related impacts, with an impact on the ability of some patients to work.
- While the fiscal impacts of the COVID-19 pandemic in general is reasonably well known and reported on across jurisdictions, the fiscal impacts are less well known, but could include decreased productivity from a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.
- There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definition.
- Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient, and an individualised management plan developed.

- There are an increasing number of guidelines available for clinical management of patients with long COVID which are briefly presented here.

Introduction

In the early stages of the pandemic, most attention was focused on the acute health impacts of SARS-CoV-2 infection.(2) It was initially thought that although some people have a prolonged and complicated hospital stay, most people recover from 'mild' infections within two weeks and from more serious disease within three weeks.(3) However, it has become clear that for some people COVID-19 can lead to persistent illness, with ongoing and often debilitating symptoms.(3-5)

This document is a summary of the current evidence known about the long-term health impacts of COVID-19, often referred to as long COVID, and the experiences of people living with long-term complications of COVID-19. It is a collation of expert opinion and the latest scientific and technical research exploring the ongoing nature or long-term presentation of signs and symptoms that appear or continue to occur after the acute phase of COVID-19, as well as aetiology, epidemiology, issues related to the impact of vaccination and new emerging variants. Developments in international guidance from peak bodies on diagnosis, management, support and rehabilitation pathways will also be explored. It reflects current knowledge at the time of writing (May 2022). It is a live and working document which will be updated as new evidence emerges, with an updated report scheduled to be shared every six to eight weeks with the Chief Allied Health Professions Office, Ministry of Health, Aotearoa New Zealand.

Long COVID terminology and definitions

Ongoing symptoms are common following many viral and bacterial infections, including other coronaviruses. The term 'long COVID' is commonly used to describe signs and symptoms that continue or develop after acute COVID-19 (four weeks from the initial infection). Symptoms may last for weeks or months after the acute illness. The presence of lingering symptoms may have a significant impact on the daily lives of those who are affected, and their family and whānau. Given the numbers of people who have been or will be infected with SARS-CoV-2 worldwide, the public health impact of long COVID could be significant.

There is no internationally agreed definition of the long COVID condition yet. However, the WHO published the following clinical case definition (created by a Delphi consensus) in October 2021:

> "Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis.
>
> Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others which generally have an impact on everyday functioning.
>
> Symptoms may be new onset, following initial recovery from an acute COVID-19 episode, or persist from the initial illness. Symptoms may also fluctuate or relapse over time. A separate definition may be applicable for children."

The Centers for Disease Control and Prevention (CDC) in the US uses the term 'post-COVID conditions' to describe long COVID, defined as a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19.

The National Institute for Health and Care Excellence (NICE) in the UK uses the following definitions to classify the long-term effects of COVID-19:

- Ongoing symptomatic COVID-19: Signs and symptoms of COVID-19 from 4 weeks up to 12 weeks.
- Post-COVID-19 syndrome: Signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis. It usually presents with clusters of symptoms, often overlapping, which can fluctuate and change over time and can affect any system in the body.

According to this NICE definition, the term 'long COVID' captures signs and symptoms that continue or develop after acute COVID-19 and includes both ongoing symptomatic COVID19 (from 4 to 12 weeks) and post COVID-19 syndrome (12 weeks or more). NICE outline that 'post-COVID-19 syndrome' may be considered before 12 weeks while the possibility of an alternative underlying disease is also being assessed.

Across the international literature, long COVID may be referred to by many names, including long COVID, long-haul COVID, post-acute COVID-19, post-acute sequelae of SARS CoV-2 infection (PASC), long-term effects of COVID, and chronic COVID.

Symptoms and Signs

There are **a range of signs and symptoms** that have been associated with long COVID. Signs and symptoms can vary greatly, and one systematic review and meta-analysis completed in early 2021 found 55 long-term effects noted across 15 studies.(6) Symptoms can be respiratory, cardiopulmonary, neurological, or generalised, as it detailed in Table 1 below.(7)

Table 1: Commonly reported symptoms of long COVID

Cardiopulmonary • Difficulty breathing or shortness of breath • Cough • Chest pain, tightness, or heaviness [1] • Palpitations **Neurological** • Cognitive impairment ('brain fog', loss of concentration or memory issues) • Headache • Sleep disturbance • Peripheral neuropathy symptoms (pins and needles, numbness) • Ongoing changes to smell or taste • Dizziness • Delirium (in older populations) **Musculoskeletal** • Muscle aches and pains	**Generalised symptoms** • Fatigue • Fever • Pain • Reduced exercise capacity **Gastrointestinal** • Abdominal pain • Nausea • Diarrhoea • Anorexia and reduced appetite (in older populations) **Ear, nose, and throat** • Tinnitus • Earache • Sore throat • Dizziness

[1] Clinical assessment is required to investigate the specific cause

• Muscle weakness[2] • Joint pain **Psychological/ psychiatric symptoms**[3] • Symptoms of depression • Symptoms of anxiety	**Other** • Skin rashes (including vesicular, maculopapular, urticarial, or chilblain-like lesions on the extremities) • Metallic or bitter taste • Metabolic disruption (such as poor control of diabetes) • Thromboembolic conditions

Some research indicates that people experiencing long COVID tend to fall into one of two symptom groups: those experiencing ongoing respiratory symptoms (including coughing and shortness of breath), combined with fatigue and headaches; and those experiencing multi-systemic symptoms, affecting the heart, brain and gut (for example, palpitations and 'brain fog').(8)

In addition to the wide range of possible symptoms, some of the key features of long COVID include:(1, 3, 5)

- Concurrence of multisystem, fluctuating and often overlapping 'clusters' of symptoms
- Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses;
- Symptom severity may range from mild to incapacitating;
- Worsening of symptoms after physical or mental activity
- Relapses may occur in an irregular pattern or in response to specific triggers (e.g. physical or mental activity, stress, menstruation, heat, or alcohol).
- People may experience new symptoms that were not present during the acute phase of their COVID-19 infection.

The most commonly reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms. One meta-analysis concluded that the effects largely corresponded with clinical symptoms including fatigue (58%), headache (44%), attention disorder or cognitive impairment/brain fogginess (27%), hair loss (25%) and dyspnea (24%) (shortness of breath).(6)

A systematic review and meta-analysis published in mid-April 2022 found over 60 physical and psychological signs and symptoms with wide prevalence were reported across 39 studies, though notably most studies had a high or moderate risk of bias. The most reported symptoms were weakness (41%; 95% CI 25% to 59%), general malaise (33%; 95% CI 15% to 57%), fatigue (31%; 95% CI 24% to 39%), concentration impairment (26%; 95% CI 21% to 32%) and breathlessness (25%; 95% CI 18% to 34%). 37% (95% CI 18% to 60%) of patients reported reduced quality of life; 26% (10/39) of studies presented evidence of reduced pulmonary function.(9)

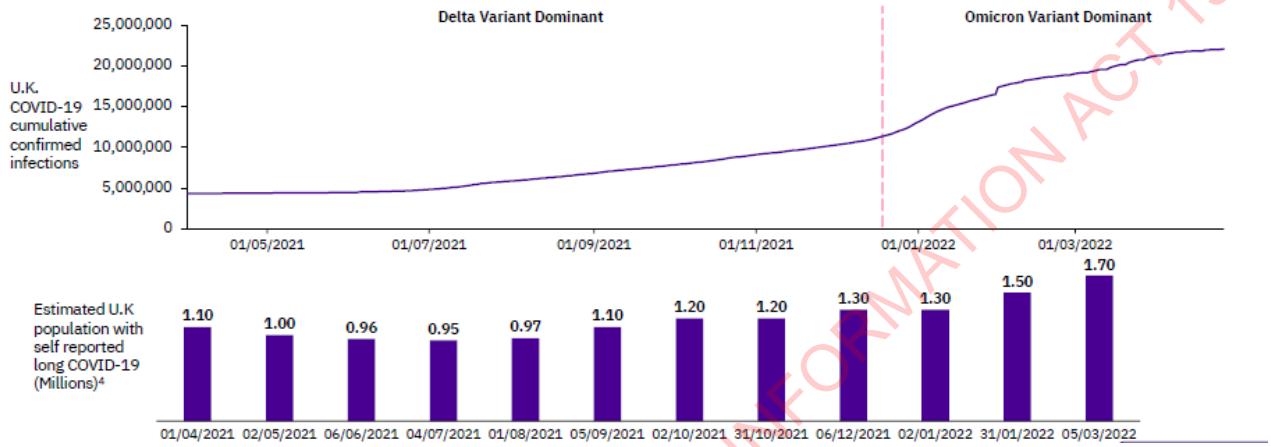
There is limited evidence on any association between how symptom presentation may differ between variants for long COVID, and this area could be confounded by a variety of factors such as the vaccination rollout, changes in treatment, as well as changes in detection and testing capacities as well as levels of community prevalence. With the high rates of community transmission of Omicron, and increased asymptomatic transmission, there is less detection of Omicron occurring, compounded by the shift to relying on rapid antigen tests. One early observational study found the Alpha variant was more likely to cause persistent cognitive symptoms when compared to the original Wuhan variant, and mental health symptoms, though these could have been influenced by a range of causes. In this same study the Alpha

[2] Muscle weakness can be a reported symptom, and may also be clinically measured
[3] The WHO has noted that the association between long COVID and psychiatric disorders is likely bidirectional

variant appeared less likely to cause impaired hearing or a loss of sense of smell compared with the original variant.(10)

Omicron

There is limited data available on Omicron, however initial evidence from the UK's ONS suggests that despite lower case severity with Omicron, these variants are still presenting a significant long COVID burden, as being driven by the higher number of cases.(link, visualisation by Airfinity)



The UK's ONS conducted a study using self-reported data from COVID-19 cases to explore the impact of Omicron BA.1 or BA.2 variants on long COVID. The data suggested

a) For boosted adults, there was no statistically significant difference in the risk of self-reported long COVID between first infections with the Delta variant and with either Omicron BA.1 or Omicron BA.2.
b) For boosted adults, the odds of reporting long COVID symptoms four to eight weeks after infection were 21.8% higher after Omicron BA.2 than Omicron BA.1.
c) For those with only a primary course of two doses, the survey found that the odds of reporting long COVID symptoms after infection were 49.7% lower in Omicron B.A1 infections than the Delta variant.

Long COVID in children

Long COVID in children is not well described, and the studies to date have generally been of poor quality, with some major limitations (such as a lack of a clear case definition, arbitrary follow up time points, subjective assessment, lack of control groups, and low response rates).(11, 12) Evidence is predominantly limited to select populations without control groups.(13) Relatively few studies have focused on SARS-CoV-2 infection sequelae in children and adolescents, and large, harmonised longitudinal studies are needed.(14) Persistent illness in children has been noted in some studies and in patient support groups, but its prevalence, characteristics and duration are unclear.(15, 16)

Estimates of the prevalence of long COVID in children vary widely.(12) The variability in prevalence estimates could be due to a range of factors, such as initial SARS-CoV-2 infection severity, different methodological approaches (clinical assessment vs self-report), definition of cases (diagnosed vs suspected), variable follow-up times, and prevalence of pre-existing clinical conditions.(13) In the US, a large long-term study of the impacts of COVID-19 on children has recently begun. It will track up to 1,000

children and young adults and evaluate the impacts on their physical and mental health over three years.[14] Some studies suggest that long COVID in children is less common and tends to be less protracted than in adults. (17)

There is some emerging evidence that signs and symptoms or **clinical presentation may differ for children**, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults. The NICE panel noted that common presentation in children is a lack of concentration, short-term memory loss, and/or difficult doing everyday tasks ≥4 weeks after acute COVID-19 illness.

Some of the studies of long COVID in children include:

- A review of studies of long COVID in children and adolescents identified 14 heterogeneous studies (4 cross-sectional, 9 prospective cohort, 1 prospective cohort) investigating long COVID symptoms in a total of 19,426 children and adolescents. The prevalence of long COVID symptoms varied from 4% to 66%, and there was also large variation in the reported frequency of different symptoms. Zimmerman et al (2021) note that all the studies in their review were likely to have been conducted before the Delta variant became dominant, which may have a different risk of long COVID.(12)
- A recent pre-print describes a German study of 157,134 individuals (11,950 children/adolescents and 145,184 adults) with confirmed COVID-19.(18) The COVID-19 and control cohorts were well-balanced regarding covariates. For all adverse health outcomes combined, incidence rates (IRs) in the COVID-19 cohort were significantly higher than those in the control cohort in both children/adolescents. Incidence rate ratio (IRR) estimates were similar for the age groups 0-11 and 12-17. Incidence rates in children/adolescents were consistently lower than those in adults. Among the specific outcomes with the highest IRR and an incidence rate of at least 1/100 person-years in the COVID-19 cohort in children and adolescents were malaise/fatigue/exhaustion, cough, and throat/chest pain.
- The UK Office of National Statistics found that 9.8% of children aged 2-11 years and 13% aged 12-16 years reported at least one ongoing symptom five weeks after a positive diagnosis, whereas 25% of adults aged 35-69-years had symptoms five weeks after a positive diagnosis.(19, 20)
- A paper describing data from the UK COVID Symptom Study (a citizen science project with data collected via an app, which has some associated limitations) found that of 1,734 children aged 5-17 years who were symptomatic at the time of their positive test and reported symptoms regularly for at least 28 days, 4.4% had an illness duration of at least 28 days.(15) Ongoing symptoms for at least 28 days was less common in younger children aged 5-11 years (3.1%, p=0.046). Over 98% of 1,379 children had recovered by 56 days.(15) However, there may be some bias as using apps is likely to select participants from higher socio-economic background, who have a lower risk of poor outcomes.(12)
- One of the earliest studies on long COVID in children (a cross-sectional study of 129 children in Italy who were diagnosed with COVID-19 between March and November 2020) reported that 42.6% of children surveyed had one or more symptoms >60 days post infection.(21) This included children with mild or asymptomatic initial infection.
- A cohort study of 136 children (most of whom had mild or asymptomatic COVID-19) in Melbourne in 2020 observed that 8% of children had post-acute symptoms. They found that full recovery occurred within weeks of acute symptom onset and reported symptoms were mild in severity but noted this was a young cohort (median age three years).(17)

Long-term SARS-CoV-2 infection–associated symptoms can be difficult to distinguish from pandemic-associated symptoms.(11, 12) Some studies have found that children who tested negative for COVID-19 have had similar symptoms, which are common after other viral infections, and could also be due to the experience of lockdown and other social restrictions.(22, 23) Given that acute COVID-19 generally poses a low risk to children, an accurate determination of the risk of long COVID is important in the debate about the risks and benefits of vaccination in this age group.(12) Similar to adults, it is likely that long COVID in children may have a greater impact on those from socioeconomically disadvantaged areas and ethnic minortity groups.(14)

In summary, "the relative scarcity of studies of long COVID and the limitations of those reported to date mean the true incidence of this syndrome in children and adolescents remains uncertain. The impact of age, disease severity and duration, virus strain, and other factors on the risk of long COVID in this age group also remains to be determined."(12) However, even if the proportion of children experiencing post-acute impacts is relatively low, if transmission is widespread (as has been with Omicron), then the impact of persisting symptoms will be considerable.

Epidemiology

Prevalence and incidence

The prevalence of long COVID is difficult to establish for a range of reasons, including:(6, 24, 25)

- Studies of long COVID have used different measurement criteria and different inclusion criteria, so they cannot be reliably compared. Studies also often differ in the way they collect data.
- Studies have focused on different groups of people, different symptoms, and time intervals, and used different sample sizes.
- Most studies report the frequency of at least one symptom (not necessarily the same symptom), rather than a cluster of symptoms.
- Published studies may not be representative of everyone who has long COVID.
- Difficulties in accessing COVID-19 testing in different countries may mask the true number of long COVID cases if studies require testing confirmation of the initial infection. In addition, testing policies vary between countries.
- The ways in which responses are elicited can impact estimated prevalence (e.g., app users are self-selected and responsible for recording symptoms, which can result in sampling and recording biases). In addition, many studies use retrospective self-reported symptoms.
- Some tools validated for other diseases may not be appropriate for use in long COVID patients.
- The prevalence of long COVID may also vary greatly depending on the groups studied (for example, app users vs population studies vs studies of patients who were hospitalised).

Despite these limitations, there is increasing evidence that a significant proportion of people experience long COVID, and there are concerns that these long term effects may occur on a scale that "could overwhelm existing health care capacity, particularly in low- and middle-income countries."(10)

Please see the below table for an overview of prevalence estimates from some key sources, systematic reviews and meta-analyses.

Paper	Population / Aim/ Number of studies	Key findings
Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 6 May 2022. The Office for National Statistics UK.	1.8 million people (self-reported)	An estimated 1.8 million people living in private households in the UK (2.8% of the population) were experiencing self-reported long COVID (symptoms persisting for more than four weeks after the first suspected coronavirus infection that were not explained by something else) as of 3 April 2022.
A systematic review and meta-analysis published in mid-April 2022(26): Chen, C., et al., *Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review.* The Journal of Infectious Diseases, 2022.	50 studies were included and 41 were part of the meta-analysis.	As of 16 April 2022, the global estimated pooled prevalence of post COVID-19 condition was 0.43 (95% CI: 0.39,0.46), or 200 million individuals. - Regional prevalence estimates were Asia— 0.51 (95% CI: 0.37,0.65), Europe— 0.44 (95% CI: 0.32,0.56), and North America— 0.31 (95% CI: 0.21,0.43). -Global prevalence for 30, 60, 90, and 120 days after infection were estimated to be 0.37 (95% CI: 0.26,0.49), 0.25 (95% CI: 0.15,0.38), 0.32 (95% CI: 0.14,0.57) and 0.49 (95% CI: 0.40,0.59), respectively. -Hospitalised and non-hospitalised patients had estimates of 0.54 (95% CI: 0.44,0.63) and 0.34 (95% CI: 0.25,0.46), respectively. - Denmark has the highest estimate of Long COVID-19 per 100,000 people (defined in this case as at least one symptom of COVID-19 up to 120 days after infection), with 23,558, followed by Andorra (23,329), and Israel (23,194). -The United States has the highest absolute number of Long COVID-19 cases, with 25,141,186, followed by India (22,824,713), and France (12,526,469).
Systematic review and meta-analysis published in August 2021 (6): Lopez-Leon, S., et al., *More than 50 long-term effects of COVID-19: a systematic review and meta-analysis.* Scientific Reports, 2021. **11**(1): p. 16144.		Estimated that the number of people with SARS-CoV-2 who developed one or more long-term symptoms could be as high as 80% of patients.
October 2021 systematic review (10): Groff, D., et al., *Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2*	The mean age was 54.4 years, and 79% were hospitalised during acute COVID-19. High-income countries	The median (IQR) proportion of COVID-19 survivors experiencing at least 1 post-acute sequelae of COVID-19 (PASC) was 54.0% (45.0%-69.0%; 13 studies) at 1 month (short-term), 55.0% (34.8%-65.5%; 38 studies) at 2 to 5 months (intermediate-term), and 54.0% (31.0%-67.0%; 9 studies) at 6 or more months (long-term).

Infection: A Systematic Review. JAMA Network Open, 2021. **4**(10): p. e2128568-e2128568.	contributed 79% of the studies.	That is, more than half of COVID-19 survivors experienced PASC 6 months after recovery.
Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ (2021) Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLoS Med 18(9): e1003773. (27)	A retrospective cohort study based on linked electronic health records (EHRs) data from 81 million patients including 273,618 COVID-19 survivors.	Among COVID-19 survivors (mean [SD] age: 46.3 [19.8], 55.6% female), 57.00% had one or more long-COVID feature recorded during the whole 6-month period (i.e., including the acute phase), and 36.55% between 3 and 6 months. Findings showed that the highest prevalence is in Asia, followed by Europe and North America. The data is limited due to being self-reported with the studies definitions of long COVID varying from 4 to 12 weeks. .

Aetiology

Long COVID is complex and there is likely to be more than one mechanism that contributes to its development. Evidence continues to emerge on the molecular contributors to long COVID, which may inform advice for management and treatment.

A range of factors have been suggested to contribute to the development of long COVID, including effects of the virus on the body (particularly on the nervous system and vascular system); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19. The current four main theories suggest possible causes may be: (link)

1) persistent virus or viral antigens causing chronic inflammation
2) autoimmunity triggered by infection
3) dysbiosis and viral reactivation
4) unrepaired tissue damage

More research is needed to better understand the potential immunological mechanisms contributing to the development of long COVID. Some people with long COVID are experiencing similar symptoms to myalgic encephalomyelitis / chronic fatigue syndrome (ME/CFS) and other post-viral infections. There is research underway to investigate how long COVID may be related to these conditions.

Risk Factors

There is a growing body of evidence on which groups are at greatest risk of developing persistent symptoms.

Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Even people who initially had no symptoms may go on to develop long COVID.(28) Long COVID is seen in all age groups. However, it appears to be less common in children and adolescents than in adults.

Some factors that may be associated with increased chance of having long COVID symptoms have been identified, and these include:

- older age (4, 8, 29) (link)
- having more than one underlying chronic medical condition or pre-existing conditions
- a higher body mass index (obesity) (29)
- being female (29, 30)(link)
- hospitalisation during acute COVID 19 (31)
- multiple early symptoms (32, 33)

In the UK's Coronavirus (COVID-19) Infection Survey, prevalence of self-reported long COVID was greatest in people aged 35 to 49 years, females, people living in more deprived areas, those working in social care, teaching and education or health care, and those with another activity-limiting health condition or disability. Notably, this was self-reported rather than from clinical diagnosis.(link)

Other factors that immunologically may predispose people to a greater risk of long COVID have been noted,(32) and these include having a greater viral load during early stages of infection, the presence of autoantibodies,(34) imbalances or compositional alterations in gut microbiome,(34, 35) and vaccination status.(36) Previous Epstein-Barr infection or a reactivation of latest viruses during initial infection has also been noted.(34, 37)

Prevention

Vaccination

The impact of vaccination prior to infection on long COVID

The UKHSA conducted a rapid evidence briefing in January 2022 which investigated the effectiveness of vaccination against long COVID.(38) This briefing collated evidence from eight studies which investigated the effectiveness of vaccination against long COVID prior to infection. Most evidence suggested full vaccination (a primary course) made participants less likely to develop long COVID symptoms after infection. This was seen in short (4 weeks), medium (12-20 weeks) and long (6 months) term timeframes after infection. In two of the eight studies, participants that were fully vaccinated were less likely to report the following symptoms in the medium to long term: fatigue, persistent muscle pain, headache, hair loss, weakness in arms and legs, shortness of breath, dizziness, anosmia, interstitial lung disease, myalgia and other pain.(38) All participants in these studies had experienced COVID-19 infections, and therefore an underestimation of the effectiveness of vaccinations in preventing long COVID is likely, as the studies did not measure cases where vaccination contributed to preventing infections altogether.

One study found that people that were fully vaccinated (defined as a primary course) prior to infection had approximately half the chance of developing symptoms that lasted longer than 28 days than people that had not been vaccinated, suggesting **a benefit in preventing long COVID**.(36) The United Kingdom's Office for National Statistics showed similar data, suggesting a 41.1% lower risk of long COVID symptoms after 12 weeks in people with at least two doses of COVID-19 vaccine when compared to people of relative socio-demographic but not fully vaccinated.

There is no data in children about the level of protection provided by vaccination against the incidence of long COVID (in addition to that from protection against infection) in those who have become infected after vaccination.

The impact of vaccination after infection on long COVID

It is recommended that after a COVID-19 infection, people should start or continue their vaccination after 3 months from recovery.

The UKHSA rapid evidence briefing also reported on 3 studies which compared people with long COVID who were infected with COVID-19 then subsequently vaccinated to participants that remained unvaccinated following infection. All three studies reported that **the cohort who received the vaccinations were significantly less likely to experience long COVID symptoms shortly after vaccination and over longer periods**.(38)

A community-based cohort study of 28,356 participants (mean age 46 years, 56% female, 89% white) from the UK's COVID-19 Infection Survey examined the trajectory of long COVID symptoms following COVID-19 vaccination. Participants were aged 18 to 69 years who received at least their first vaccination after test-confirmed infection. The study had a median follow-up of 141 days from first vaccination (among all participants) and 67 days from second vaccination (84% of participants). First vaccination was associated with an initial 12.8% decrease (95%CI: −18.6% to −6.6%) in the odds of long COVID, but increasing by 0.3% (−0.6% to +1.2%) per week after the first dose. Second vaccination was associated with an 8.8% decrease (−14.1% to −3.1%) in the odds of long COVID, with the odds subsequently decreasing by 0.8% (−1.2% to −0.4%) per week. There was no statistical evidence of heterogeneity in associations between vaccination and long COVID by socio-demographic characteristics, health status, whether hospitalised with acute COVID-19, vaccine type (adenovirus vector or mRNA), or duration from infection to vaccination.(39)

As part of a federated research study with the COVID-19 Patient Recovery Alliance, Arcadia Data Research (Arcadia.io) performed a retrospective analysis of the medical history of 240,648 COVID-19-infected persons to identity factors influencing the development and progression of long COVID. Data were captured directly from electronic health record (EHR) systems, practice management systems. This analysis revealed that patients who received at least one dose of any of the three COVID vaccines available in the US (Pfizer, Modern or Janssen) prior to their diagnosis with COVID-19 were 7-10 times less likely to report two or more long-COVID symptoms compared to unvaccinated patients. Furthermore, unvaccinated patients who received their first COVID-19 vaccination within four weeks of SARS-CoV-2 infection were 4-6 times less likely to report multiple long-COVID symptoms, and those who received their first dose 4-8 weeks after diagnosis were 3 times less likely to report multiple long COVID symptoms compared to those who remained unvaccinated. The study authors argue that this relationship supports the hypothesis that **COVID-19 vaccination is protective against long COVID and that effect persists even if vaccination occurs up to 12 weeks after COVID-19 diagnosis**.(40)

Additionally, one study assessed the timing of vaccination following COVID diagnosis and concluded that people who were vaccinated sooner were likely to report less long COVID symptoms than unvaccinated people. However, in both vaccinated and unvaccinated people following infection, most people (up to 70%) reported no change to long COVID symptoms after vaccination.(41) The study population were limited to 44 vaccinated patients with 22 matched unvaccinated patients, and therefore larger studies are needed.

A study in the UK surveyed 900 people living with long COVID and evaluated the impact of their first COVID-19 vaccination on their symptoms. In this 57.9% of people reported an improvement to symptoms, 24.2%

no change and 17.9% reported deterioration. The report also stated that people who received mRNA vaccines tended to report larger levels of improvement compared to adenovector vaccines. This is the largest survey to date of people living with long COVID, however due to the self-reporting nature of the survey, it is noted that a randomised controlled trial would be required confirm any direct links between that it observed between vaccination and improvement to long COVID symptoms.(42)

Impacts

Psychosocial impacts

The functional impairment experienced by some people with long COVID and the toll managing symptoms has on quality of life is becoming clearer. An early patient-led study of 3,762 self-described long haulers in 56 countries found 45.2% (42.9% to 47.2%) reported requiring a reduced work schedule compared to pre-illness and 22.3% (20.5% to 24.3%) were not working at the time of the survey due to their health conditions.(43).

Long COVID patients are **reporting multiple psychosocial impacts, including mental health related impacts**. This includes reporting experiences of feeling depressed, anxious, or worried.(44) (44)Another article considering guidance to support patients experiencing long COVID found several specific mental health challenges, including: post-traumatic stress disorder (PTSD), major depressive disorder, anxiety disorders, sleep disorders, phobias, fears with avoidant behaviours, health anxieties, obsessive-compulsive disorder (OCD) and adjustment disorder related to living with long COVID-19 symptoms, social exclusion and addictions (as a form of coping), and neuropsychiatric disorders.(45)

Additionally, **long COVID has had an impact on the ability of some patients to work.** People with ongoing symptomatic COVID-19 or post-COVID-19 syndrome who report increased absence or reduced performance in education or work may need extra support and recovery time.(46) Long COVID therefore limits the ability of people to return to work and to socialise, not only potentially further affecting their mental health, but also having economic consequences for them, their whānau and society.(5)

Overall, long COVID is having an impact on reported quality of life. An online survey study completed in 2021 found an overall reduction in quality of life, and this was due to a range of the symptoms reported which included sleep quality, breathlessness, physical activity and mental health.(44)

Social and economic impacts

While the fiscal impacts of the COVID-19 pandemic in general is well known and reported on across jurisdictions, **the fiscal impacts of long COVID specifically are less well known and scarcely reported on, as the impacts are hard to quantify given the wide variety of variables involved**. The impact of long COVID can be looked at from multiple angles, from **decreased productivity from a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.**

The Solve Long COVID initiative, a non-profit research and advocacy group in the United States has estimated that the disability caused by long COVID has cost $386 billion dollars in the United States alone, when considering only the personal financial impact on affected individuals, like lost wages, lost savings, and healthcare costs, from the beginning of the pandemic through to January 31 2022.(link)

Further work to measure the financial impact of long COVID is still required to fully understand its scale. Countries across the globe have committed varying levels of financial resources to diagnose, understand

and treat the condition, but research and reporting regarding the overall financial impact and the second and third order financial effects of long COVID is currently scarce.

The social and economic burden of long COVID will affect Māori and Pacific peoples to a greater degree, as they have accounted for a greater proportion of cases during Aotearoa New Zealand's Delta and Omicron outbreaks.

Treatment and Support

Diagnosis

There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definitions of long COVID (as is detailed above).

Although there are a wide range of symptoms that can present for long COVID, many of these symptoms are common from a multitude of other conditions, making them hard to decipher or confirm as long COVID. Additionally, ongoing symptoms may vary widely and will affect people in diverse ways, and symptoms can be diverse with multiorgan involvement. Long COVID is multi-factorial, and more than one mechanism may be implicated in clinical presentations.(47)

Compounding the lack of clear definitions, due to the relative newness of the condition, there may be a limited amount of knowledge of the condition known by many health care professionals.

There is currently no specific tests to aid in the diagnosis.

Models of care

Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient,(5) and an individualised management plan developed.(48) Some patients may find it useful to keep track of their symptoms. Keeping a log of symptoms can help better understand them, identify which symptoms impact them most, and identify patterns and changes in their symptoms.(49)

Internationally, multidisciplinary teams are working together to tackle the unique symptoms each patient experiences and tailoring treatment to them.(3) Countries are creating dedicated treatment guidelines and care pathways, and the US, UK and Germany have opened post-COVID clinics as one-stop-shops for treatment and support. For example, an Adult Post-Acute COVID clinic at Vanderbilt University brings together specialists from internal medicine, infectious disease, pulmonology, cardiology, ophthalmology, psychology, physical medicine, ear, nose and throat, speech pathology and neurology.(3) Physical therapy, physiotherapy, and occupational therapy have also been key tools used for those struggling with fatigue. Nutritional support has also been important, with lethargy having flow-on effects onto the ability to cook and prepare food, resulting in some struggling with malnutrition.(50)

Specific symptom management will usually be pragmatic, with avoidance of over-investigation.(48, 51)

For Aotearoa New Zealand, an equity focus with a co-design approach with key affected communities of those living with long COVID, Māori and Pacific peoples is key. Patient and peer support networks have played a key role in the initial response to long COVID.

International guidelines on rehabilitation and management

Existing international guidelines propose that the initial management of long COVID should be in primary care and should include a series of investigations both to characterise how the individual is affected and to exclude other conditions that may coexist. Management, referrals and care pathways should then be tailored to the manifestations of disease, including investigation and referral for signs of involvement of different organ systems (5). The patient voice has been critical in shaping awareness of long COVID internationally and within New Zealand, and patient- and whānau-centred care should continue to be the focus.

Alongside treatment options, support and care services may be needed for people with persistent symptoms. Counselling and psychological support may be needed to address high rates of poor mental health, and many of the post-COVID clinics set up throughout the US and UK contain psychology services or referrals.(52)

There are an increasing number of guidelines available for clinical management of patients with long COVID. Some of these are listed below. These might be useful to consult when developing New Zealand specific guidelines.

Source	Title	Date	Link	Notes
Australian National COVID-19 Clinical Evidence	Australian Guidelines for the clinical care of people with COVID-19: Post COVID-19	Living Guidelineslast updated 9 May 2022	https://app.magicapp.org/#/guideline/L4Q5An/section/jDJJJQ	Guidance for clinicians on: - Assessing and diagnosing post-COVID conditions - A consensus recommendation of symptoms and signs - Management and care of people with post-COVID-19 condition
National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and Royal College of General Practitioners (RCGP)	COVID-19 rapid guideline: managing the longterm effects of COVID-19	Version 1.14 published on 01.03.2022	https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-510355157422	Guidance for clinicians on: - Identification - Assessment - Investigations and referral - Planning care - Management (including self-management or supported management, multidisciplinary rehabilitation, and additional support) - Follow-up, monitoring and discharge - Sharing information and continuity of care - Service organisation - Common symptoms - Equality considerations
Centres for Disease Control and Prevention (CDC), USA	Interim Guidance on Evaluating and Caring for Patients with Post-	June 2021	https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-	Includes guidance on general clinical considerations, patient history and physical examinations, assessment and testing, management and public health recommendations. The guidelines argue many post-COVID conditions can be managed by primary care providers, with the incorporation of patient-centered approaches to optimise the quality of life and function in affected patients.

	COVID Conditions		covid-index.html	Objective laboratory or imaging findings should not be used as the only measure or assessment of a patient's well-being; lack of laboratory or imaging abnormalities does not invalidate the existence, severity, or importance of a patient's symptoms or conditions. Healthcare professionals and patients are encouraged to set achievable goals through shared decision-making and to approach treatment by focusing on specific symptoms (e.g., headache) or conditions (e.g., dysautonomia); a comprehensive management plan focusing on improving physical, mental, and social wellbeing may be helpful for some patients.
BMJ Practice Pointer (51)	Management of post-acute COVID-19 in primary care	Aug 2020	https://www.bmj.com/content/370/bmj.m3026	Guidance for the management of people with long COVID in primary care.
The Royal Australian College of General Practitioners (48)	Caring for adult patients with postCOVID-19 conditions.	Oct 2020	https://www.racgp.org.au/FSDEDEV/media/documents/RACGP/Coronavirus/Post-COVID-19-conditions.pdf	This document aims to support general practice to collaborate with local hospital services in the care of patients with these conditions.
Scottish Intercollegiate Guidelines Network (SIGN) (53)	Managing the long-term effects of COVID-19	Dec 2020	https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf	This document covers care for people who have symptoms that develop during or after an infection consistent with COVID-19, continue for more than four weeks and are not explained by an alternative diagnosis. It also provides advice on diagnosis and management based both on the best available evidence and the knowledge and experience of the expert panel.
Ontario Health	Post-COVID-19 Condition: Guidance for Primary Care	Dec 2021	https://www.ontariohealth.ca/sites/ontariohealth/files/2021-12/PostCovidConditionsClinicalGuidance_EN.pdf	This document includes guidance for primary care on: - Assessment - Testing - Diagnosis - Physical examination - Management
Chartered Society of Physiotherapy	COVID-19 Rehabilitation Standards	August 2021	https://www.csp.org.uk/publications/covid-19-community-rehabilitatio	UK guidance for physiotherapy service delivery for adults who are hospitalised due to acute COVID-19 or long COVID

			n-physiotherapy-service-delivery	

Policy Responses

The full magnitude of the long COVID burden globally is still yet to be known, with countries all at varying stages of their response to COVID-19, with some only having experienced significant outbreaks following the emergence of the Omicron variant, resulting in a lack of first-hand experience in addressing long COVID and undeveloped systems to respond to and report on long COVID.

In order for an equitable policy response in Aotearoa New Zealand, partnership and shared decision-making with key affected communities, including those with long COVID, the Māori Health Authority, the Ministry for Pacific Peoples, and the New Ministry for Disabled People.

United Kingdom: The UK government has set up over 80 specialist clinics[i] to provide support to those suffering from long COVID, which provide psychological and physiological support services. Further research funding is being provided through grants to NGOs and healthcare providers through the National institute of health, to date only around 50 million pounds of funding has been provided for research in to Long COVID.[ii] The UK government has made Statutory Sick Payments, Universal Credit or Employment and Support Allowance (ESA) available to people if Long COVID affects how much they can work. Affected individuals can also apply for a Personal Independence Payment if they have difficulty with everyday tasks and getting around.[iii] The UK's response has endeavoured to provide all information in accessible and age-appropriate formats so that people can understand and take part in decisions about their care, as guided by the NICE guidelines on shared decision making and good patient experiences.

United States: As of July 2021, long COVID, also known as post-COVID conditions, can be considered a disability under the Americans with Disabilities Act.[iv] President Joe Biden has directed federal agencies to support patients and doctors by providing science-based best practices for treating long COVID, maintaining access to insurance coverage, and protecting the rights of workers as they try to return to jobs while coping with the uncertainties of the malaise.[v]

France: Since the French government identified Long COVID at the end of the first wave of the virus in spring 2020, it has been watching the issue closely in order to care for those affected and to better understand the disease. On 17 March 2022, the Health Minister published a statement recognising Long COVID as a health concern in France and acknowledging the necessity for ongoing research into its prevalence, diagnosis, and treatment.[vi]

Germany: The German Government has committed to the establishment of a Germany-wide network of 2,580 competence centres and interdisciplinary outpatient clinics to further research and ensure needs-based care around the long-term effects of COVID-19. German physicians dealing with Long COVID have established a dedicated national association, with thirteen specialised working groups, to promote research, share information and improve the treatment of patients suffering from Long COVID.

Sweden: The Swedish government has implemented a number of responses to Long COVID. It has supported research on COVID-19 through funding to the Swedish Research Council and tasked the Swedish Agency for Health and Care Services Analysis with mapping Long COVID care across the country. The National Board of Health and Welfare has produced guidelines and statistical reports to support the health

and welfare system in meeting the needs of Long COVID sufferers. However, the general lack of information about the condition, and awareness of it, as well as the immense pressure on the healthcare system during the pandemic, means that a system for testing and assessment, treatment, and support available to sufferers is not yet fully functioning.[vii]

Next Steps	Share with CAPHO
In the development of this work, the following parties have been consulted with:	

Resources used:		
Ministry of Health Policies and Procedures	☒ Yes ☐ No	
External Health Scientific organisations	☐ Yes ☐ No	
Existing database of RFAs	☒ Yes ☐ No	
Internal Ministry of Health Advice	☒ Yes ☐ No	
External Expert Advice	☐ Yes ☐ No	
Literature Review	☒ Yes ☐ No	

1. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188] 2021 [updated 11 November 2021. Available from: https://www.nice.org.uk/guidance/ng188.
2. Leung TYM, Chan AYL, Chan EW, Chan VKY, Chui CSL, Cowling BJ, et al. Short- and potential long-term adverse health outcomes of COVID-19: a rapid review. Emerg Microbes Infect. 2020;9(1):2190-9.

3. National Institute for Health Research. Living with COVID19 2020 [updated 15 October 2020. Available from: https://evidence.nihr.ac.uk/themedreview/living-with-covid19/#Conclusions
4. The Royal Society. Long Covid: what is it, and what is needed? 2020 [updated 23 October 2020. Available from: https://royalsociety.org/-/media/policy/projects/set-c/set-c-long-covid.pdf
5. World Health Organization (WHO). Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID Copenhagen, Denmark: WHO,; 2021 [Available from: https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf.
6. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, et al. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. Scientific Reports. 2021;11(1):16144.
7. Cau R, Faa G, Nardi V, Balestrieri A, Puig J, Suri JS, et al. Long-COVID diagnosis: From diagnostic to advanced AI-driven models. European Journal of Radiology. 2022;148:110164.
8. COVID Symptom Study. Long COVID: What do we know so far? 2021 [updated 12 April 2021. Available from: https://covid.joinzoe.com/post/long-covid-what-we-know.
9. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. BMJ Global Health. 2021;6(9):e005427.
10. Groff D, Sun A, Ssentongo AE, Ba DM, Parsons N, Poudel GR, et al. Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review. JAMA Network Open. 2021;4(10):e2128568-e.
11. Murdoch Children's Research Institute (MCRI). Research Brief: COVID-19 and Child and Adolescent Health Victoria, Australia: MCRI,; 2021 [updated 13 September 2021. Version 1:[Available from: https://www.mcri.edu.au/sites/default/files/media/documents/covid-19-and-child-and-adolescent-health-140921.pdf.
12. Zimmermann P, Pittet LF, Curtis N. How Common is Long COVID in Children and Adolescents? The Pediatric Infectious Disease Journal. 2021;40(12).
13. Radtke T, Ulyte A, Puhan MA, Kriemler S. Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents. JAMA. 2021;326(9):869-71.
14. Munblit D, Sigfrid L, Warner JO. Setting Priorities to Address Research Gaps in Long-term COVID-19 Outcomes in Children. JAMA Pediatrics. 2021;175(11):1095-6.
15. Molteni E, Sudre CH, Canas LS, Bhopal SS, Hughes RC, Antonelli M, et al. Illness duration and symptom profile in symptomatic UK school-aged children tested for SARS-CoV-2. The Lancet Child & Adolescent Health. 2021:708-18.
16. Sigfrid L, Drake TM, Pauley E, Jesudason EC, Olliaro P, Lim WS, et al. Long Covid in adults discharged from UK hospitals after Covid-19: A prospective, multicentre cohort study using the ISARIC WHO Clinical Characterisation Protocol 2021 [2021.03.18.21253888]. Available from: http://medrxiv.org/content/early/2021/03/23/2021.03.18.21253888.abstract.
17. Say D, Crawford N, McNab S, Wurzel D, Steer A, Tosif S. Post-acute COVID-19 outcomes in children with mild and asymptomatic disease. The Lancet Child & Adolescent Health. 2021;5(6):e22-e3.
18. Roessler M, Tesch F, Batram M, Jacob J, Loser F, Weidinger O, et al. Post COVID-19 in children, adolescents, and adults: results of a matched cohort study including more than 150,000 individuals with COVID-19 2021 [2021.10.21.21265133]. Available from: http://medrxiv.org/content/early/2021/10/22/2021.10.21.21265133.abstract.
19. Office for National Statistics UK. Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK 2021 [Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/alldatarelatingtoprevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk.
20. Lewis D. Long COVID and kids: scientists race to find answers: Nature; 2021 [updated 18 November 2021. Available from: https://www.nature.com/articles/d41586-021-01935-7?utm_source=twt_nat&utm_medium=social&utm_campaign=nature.
21. Buonsenso D, Munblit D, De Rose C, Sinatti D, Ricchiuto A, Carfi A, et al. Preliminary evidence on long COVID in children. Acta Paediatrica. 2021.

22. Jason LA, Katz BZ, Shiraishi Y, Mears CJ, Im Y, Taylor R. Predictors of Post-Infectious Chronic Fatigue Syndrome in Adolescents. Health Psychol Behav Med. 2014;2(1):41-51.
23. Katz BZ, Shiraishi Y, Mears CJ, Binns HJ, Taylor R. Chronic fatigue syndrome after infectious mononucleosis in adolescents. Pediatrics. 2009;124(1):189-93.
24. Martin C, Luteijn M, Letton W, Robertson J, McDonald S. A model framework for projecting the prevalence and impact of Long-COVID in the UK. PloS one. 2021;16(12):e0260843-e.
25. Ministry of Health NZ. Long COVID 2021 [updated 21 June 2021. Available from: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.
26. Chen C, Haupert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review. The Journal of Infectious Diseases. 2022.
27. Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ. Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLOS Medicine. 2021;18(9):e1003773.
28. Centers for Disease Control and Prevention (CDC). Post-COVID Conditions: Overview 2021 [updated 9 July 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Fclinical-care%2Flate-sequelae.html.
29. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Risk factors for long COVID: analyses of 10 longitudinal studies and electronic health records in the UK. medRxiv. 2021:2021.06.24.21259277.
30. Stewart S, Newson L, Briggs TA, Grammatopoulos D, Young L, Gill P. Long COVID risk - a signal to address sex hormones and women's health. The Lancet Regional Health – Europe. 2021;11.
31. Ziyad Al-Aly BB, Yan Xie et al. Long Covid after Breakthrough COVID-19: the post-acute sequelae of breakthrough COVID-19. PREPRINT (Version 1) available at Research Square [https://doiorg/1021203/rs3rs-1062160/v1]. 2021.
32. Cervia C, Zurbuchen Y, Taeschler P, Ballouz T, Menges D, Hasler S, et al. Immunoglobulin signature predicts risk of post-acute COVID-19 syndrome. Nat Commun. 2022;13(1):446.
33. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, et al. Attributes and predictors of long COVID. Nature Medicine. 2021;27(4):626-31.
34. Su Y, Yuan D, Chen DG, Ng RH, Wang K, Choi J, et al. Multiple early factors anticipate post-acute COVID-19 sequelae. Cell. 2022;185(5):881-95.e20.
35. Liu Q, Mak JWY, Su Q, Yeoh YK, Lui GC-Y, Ng SSS, et al. Gut microbiota dynamics in a prospective cohort of patients with post-acute COVID-19 syndrome. Gut. 2022;71(3):544.
36. Antonelli M, Penfold RS, Merino J, Sudre CH, Molteni E, Berry S, et al. Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study. The Lancet Infectious Diseases. 2022;22(1):43-55.
37. Gold JE, Okyay RA, Licht WE, Hurley DJ. Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation. Pathogens. 2021;10(6):763.
38. UK Health Security Agency. The effectiveness of vaccination against long COVID. A rapid evidence briefing 2022 [Available from: https://ukhsa.koha-ptfs.co.uk/cgi-bin/koha/opac-retrieve-file.pl?id=fe4f10cd3cd509fe045ad4f72ae0dfff.
39. Ayoubkhani D, Bermingham C, Pouwels KB, Glickman M, Nafilyan V, Zaccardi F, et al. Changes in the trajectory of Long Covid symptoms following COVID-19 vaccination: community-based cohort study. medRxiv. 2021:2021.12.09.21267516.
40. Simon MA, Luginbuhl RD, Parker R. Reduced Incidence of Long-COVID Symptoms Related to Administration of COVID-19 Vaccines Both Before COVID-19 Diagnosis and Up to 12 Weeks After. medRxiv. 2021:2021.11.17.21263608.

41. Arnold DT, Milne A, Samms E, Stadon L, Maskell NA, Hamilton FW. Are vaccines safe in patients with Long COVID? A prospective observational study 2021 [2021.03.11.21253225]. Available from: http://medrxiv.org/content/early/2021/03/14/2021.03.11.21253225.1.abstract.

42. Strain WD, Sherwood O, Banerjee A, Van der Togt V, Hishmeh L, Rossman J. The Impact of COVID Vaccination on Symptoms of Long COVID: An International Survey of People with Lived Experience of Long COVID. Vaccines. 2022;10(5):652.

43. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing Long COVID in an International Cohort: 7 Months of Symptoms and Their Impact 2021 [2020.12.24.20248802]. Available from: http://medrxiv.org/content/early/2021/04/05/2020.12.24.20248802.abstract.

44. Faghy MA, Maden-Wilkinson T, Arena R, Copeland RJ, Owen R, Hodgkins H, et al. COVID-19 patients require multi-disciplinary rehabilitation approaches to address persisting symptom profiles and restore pre-COVID quality of life. Expert Review of Respiratory Medicine. 2022:1-6.

45. Hussain FA. Facilitating care: a biopsychosocial perspective on long COVID. British Journal of General Practice. 2022;72(714):30-1.

46. NICE SaR. COVID-19 rapid guideline: managing the longterm effects of COVID-19. 2021 Contract No.: 16.5.22.

47. Maltezou HC, Pavli A, Tsakris A. Post-COVID Syndrome: An Insight on Its Pathogenesis. Vaccines (Basel). 2021;9(5).

48. RACGP. Caring for adult patients with post-COVID-19 conditions East Melbourne, VIC2020 [

49. The National Institute for Health Innovation. Long COVID 2021 [Available from: https://www.nihi.auckland.ac.nz/long-covid.

50. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, et al. Post-acute COVID-19 syndrome. Nature Medicine. 2021;27(4):601-15.

51. Greenhalgh T, Knight M, A'Court C, Buxton M, Husain L. Management of post-acute covid-19 in primary care. BMJ. 2020;370:m3026.

52. Walter K. An Inside Look at a Post–COVID-19 Clinic. JAMA. 2021.

53. Scottish Intercollegiate Guidelines Network. SIGN 161: Managing the long-term effects of COVID-19: National guidance for identification, assessment and management Edinburgh: SIGN; 2020 [updated 18 December 2020. Available from: https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf.

[i] British Medical Journal – COVID-19 How Europe is approaching long COVID - https://www.bmj.com/content/376/bmj.o158 - Accessed 13 May 2022

[ii] The Guardian - I have long Covid and despair that the UK government ignores its blight - https://www.theguardian.com/commentisfree/2022/apr/03/i-have-long-covid-despair-that-government-ignores-its-blight - Accessed 13 May 2022

[iii] UK Government - Find help and support if you have long COVID - https://www.gov.uk/guidance/find-help-and-support-if-you-have-long-covid#if-you-have-long-covid-and-are-unable-to-work – Accessed 13 May 2022

[iv] US CDC – Long COVID or Post COVID Conditions - https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/ - Accessed 10 May 2022

[v] https://www.pbs.org/newshour/health/biden-orders-research-push-on-long-covid-a-still-mysterious-condition - Accessed 13 May 2022

[vi] FORMAL MESSAGE: COVID-19: REQUEST FOR REPORTING – LONG COVID- FRENCH RESPONSE Unclassified – 03 May 2022

[vii] FORMAL MESSAGE: COVID-19: REQUEST FOR REPORTING – LONG COVID: SWEDEN Unclassified – 04 May 2022

Document 6

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

This form contains the details relevant to the questions posed to the Science and Technical Advisory (STA). STA will respond to the request using this form which will also be stored in STA content management system for future reference.

This form, or parts of it, may also be forwarded to other relevant parties as appropriate.

Title	Long COVID Evidence Update		
Subject	Underlying science and long-term health impacts of COVID-19		
Reference No.	526	Date Received	20/05/2022
Requestor	Martin Chadwick, Chief Allied Health Professions Officer from the Ministry of Health.	Date Due	1/07/2022
Advisor	Eloise Williams, Senior Advisor Sarah Mitchell, Senior Advisor Fiona Stephens, Senior Advisor Brittany Illingworth, Advisor	Date Completed	1/07/2022
Peer reviewed by	Mark Ayson, Principal Advisor Brooke Hollingshead, Team Leader		
Advice issued to	Martin Chadwick, Chief Allied Health Professions Officer		
Approved by	Dan Bernal, Manager, Science & Technical Advisory		
Deliverables	A review of the evidence and health impacts on long-term effects of COVID-19		

Request Outline

Background/Context

In developing a work programme for long COVID, CAHPO have requested a regular update on what is known about the science and evidence on long COVID, and awareness of what other countries are establishing to support people with this condition.

Questions

Long COVID terminology and definitions	• What are the various terms used to describe ongoing health effects following the acute COVID-19 illness? • What are the clinical case definitions used by various organisations/ countries?

Diagnosis	• What are the limitations or challenges in making a diagnosis of long COVID? • Are there any tests available to assist with diagnosing the condition? (e.g., immune function tests)
Symptoms and signs	• Outline the range of symptoms and signs that have been associated with long COVID • Which symptoms are most common? • Disease course - pattern and severity of symptoms • Is there any association between particular variants and the types of long COVID symptoms?
Psychosocial impacts	• What kinds of mental health impacts are long COVID patients experiencing? • What impact can long COVID have on ability to work? • How does long COVID impact on quality of life overall?
Prevalence/ incidence	• What is the estimated prevalence of long COVID in various groups, including by: age (including children), ethnicity (including Indigenous), remote/rural geography, social and economic status, gender, severity of initial infection, hospitalised vs non-hospitalised, and at various timeframes after the acute illness?
	• What is the estimated prevalence of long COVID in key countries, according to sources in country? Which demographics have been most impacted by long COVID (e.g., in terms of gender, age, and ethnicity)? Key countries could include Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain.
Aetiology	• What are the proposed mechanisms which contribute to the development of long COVID?
Risk factors	• What are the risk factors for developing long COVID?
Treatment and support	• Are there established treatments and supports known to help patients with long COVID? • What are the other treatments being investigated for long COVID patients? • What models of care are other countries putting in place/ exploring? • What guidelines do other countries/ organisations have in place for rehabilitation of patients with long COVID?
Prevention (see also, vaccination)	• Aside from vaccination, are there any other ways to reduce the risk of developing long COVID once infected with SARS-CoV-2? (e.g., importance of rest during acute illness)

Vaccination	• Does vaccination before infection reduce the symptoms or incidence of long COVID? • Does previous vaccination affect severity of symptoms in people with long COVID? • Is it considered safe for patients with long COVID to receive COVID-19 vaccines? • Does vaccination of patients with existing long COVID affect their symptoms/ disease course?
Social and economic impact	• What are the current and projected economic impacts of long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain, according to sources in country? *(Including workforce impacts such as sick days/absences, financial costs to employers, impacts on sectors).*
Policy responses	• How have governments responded to long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain, according to sources in country? • Has the government classed long COVID as a disability? • What social support schemes are available for people with long COVID? • What are government recommendations to employers around how to manage employees with long COVID? • What are the current treatment pathways available for those facing long COVID and what barriers are people facing in accessing these pathways?

Intended application of advice

To inform development of support packages and rehabilitation pathways for people with long COVID.

Timeline

First evidence brief was sent on Friday 20 May 2022. This next update is due to CAHPO on 1 July 2022.

What are the implications and considerations of this advice on Te Tiriti o Waitangi and equity?	COVID-19 has disproportionately affected vulnerable populations and exacerbated existing inequities, and the burden of long COVID is likely to continue this trend. In New Zealand, Māori and Pacific peoples make up an increasing proportion of COVID-19 cases, so long COVID may have a particularly high burden in these populations. They may also face additional barriers seeking or accessing treatment for long COVID or financial barriers to affording treatment due to existing healthcare access issues being exacerbated by difficulties in diagnosis and accessing care pathways.

For some people, long COVID results in being unable to work for an extended period. Support options for these situations need to be considered. In addition, long COVID is a complex condition that may not be adequately understood or recognised by the medical profession, creating further difficulties for patients seeking validation of their experience and support, worsening existing access and equity issues.

Throughout this report, we will consider equity considerations, and specifically explore questions related to: What equity issues are evident in long COVID experiences and responses overseas? Are there any useful examples from overseas of how to ensure long COVID is addressed equitably? How might New Zealand experience inequities with respect to long COVID and how could these be mitigated?

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

Long COVID Evidence Update

Key Points

- No international definition has been agreed upon for ongoing symptoms following acute SARS-CoV-2 infection, and the time period of ongoing symptoms varies from 4 weeks to 12 weeks and onwards.
- The New Zealand Ministry of Health has received recommendations from the Long COVID Expert Advisory Group and agreed to adopt a consistent clinical case definition for long COVID to use in Aotearoa New Zealand. The joint guideline by the National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and the Royal Colleage of General Practitioners (RCGP) will be adopted to distinguish between ongoing COVID and long COVID cases. This definition differentiates acute COVID-19 (signs and symptoms up to 4 weeks) from ongoing symptomatic COVID-19 (4 weeks to 12 weeks) from Post-COVID-19 syndrome (from 12 weeks).
- There are a range of signs and symptoms that have been associated with long COVID. Symptoms can be respiratory, cardiopulmonary, neurological, or systemic. They can be concurrent, fluctuating and overlapping. Symptoms vary in severity and site over time, including symptom-free periods followed by relapses. The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, and respiratory symptoms.
- Long COVID in children is not well described, and prevalence estimates vary widely. There is some emerging evidence that signs and symptoms or clinical presentation may differ for children, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults.
- The prevalence of long COVID is difficult to establish for a range of reasons, however preliminary studies suggest that approximately 30% of people who test positive for COVID-19 experience symptoms for 12 weeks or longer.(1)
- Preliminary results from the 'Ngā Kawekawe o mate korona – The impacts of COVID-19 in Aotearoa study' found that in 65 Māori participants, 43% (28 participants) reported symptoms for more than one month, and of these participants, 75% (21 participants) reported experiencing symptoms for more than three months post-infection. In comparison, of the 405 participants who were non-Māori, 47% (190) reported symptoms for more than one month, and of these individuals, 65% (124) reported symptoms which lasted more than 3 months. Therefore while similar proportions reported ongoing symptoms, slightly more Māori participants reported symptoms for three months or longer.
- Evidence continues to emerge on the cause/s of long COVID. A range of factors have been suggested to contribute, including effects of the virus on the body (particularly on the nervous and vascular systems); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19. Some emerging research has found that even mild cases of COVID-19 could lead to inflammation of the brain, which could help to explain the persistent cognitive impairment often termed 'brain fog' reported by many with long COVID.
- Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but it can also affect those who initially had mild or moderate COVID-19. Some factors that have been associated with an increased risk of long COVID include age, having underlying health conditions, a higher body mass index, and being female. Vaccines are important in preventing long COVID and are effective prior to infection and post-infection.
- In Aoteaora New Zealand, Māori may have an increased risk of developing long COVID given the higher rates of COVID-19 in this group, and lower vaccination rates. The potential inequitable impact of long COVID on Māori is concerning and is receiving recent media attention (link).

- A new study case-control study from the UK has found that the risk of ongoing symptoms or long COVID after Omicron infection is approximately half of the risk after Delta infection. Although the percentage of Omicron infections leading to long COVID were lower, the absolute numbers are still expected to be greater than for Delta due to the increased numbers that were infected by Omicron, and therefore the impact on the health system could still be significant.
- The effect of vaccination on pre-existing long COVID remains uncertain and contentious, though most studies comparing long COVID symptoms before and after vaccination reported an improvement in symptoms after vaccination, either immediately or over several weeks.
- Long COVID patients are reporting multiple psychosocial impacts, including mental health related impacts, affecting the ability of some patients to work.
- While the fiscal impacts of the COVID-19 pandemic, in general, is reasonably well known and reported on across jurisdictions, the fiscal impacts of long-term health impacts and long COVID are less well known but could include decreased productivity from a reduction of participants in the workforce, to costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.
- Preliminary analysis from Ngā Kawekawe o Mate Korona has found that 45% of Māori with long COVID say their usual activities have been affected to a moderate or extreme level; about 20% have severe pain and about 10% have difficulty moving.
- There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definition.
- Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options likely vary for people with long COVID. There is an emerging consensus on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient, and development of an individualised management plan.
- There are an increasing number of international guidelines available for clinical management of patients with long COVID which are briefly presented here. Currently, there are no collated Aotearoa New Zealand resources for symptom management.

Introduction

In the early stages of the pandemic, most attention was focused on the acute health impacts of SARS-CoV-2 infection.(2) It was initially thought that although some people have a prolonged and complicated hospital stay, most people recover from 'mild' infections within two weeks and from more serious disease within three weeks.(3) However, it has become clear that for some people COVID-19 can lead to persistent illness, with ongoing and often debilitating symptoms.(3-5)

This document is a summary of the current evidence known about the long-term health impacts of COVID-19, often referred to as long COVID, and the experiences of people living with long-term complications of COVID-19. It is a collation of expert opinion and the latest scientific and technical research exploring the ongoing nature or long-term presentation of signs and symptoms that appear or continue to occur after the acute phase of COVID-19, as well as aetiology, epidemiology, issues related to the impact of vaccination and new emerging variants. Developments in international guidance from peak bodies on diagnosis, management, support, and rehabilitation pathways will also be explored. It reflects current knowledge at the time of writing (July 2022). It is a live and working document which will be updated as new evidence

emerges, with an updated report scheduled to be shared every six to eight weeks with the Chief Allied Health Professions Office (CAHPO), Ministry of Health, Aotearoa New Zealand. New evidence in this update will be in red.

Long COVID terminology and definitions

Ongoing symptoms are common following many viral and bacterial infections, including other coronaviruses. The term 'long COVID' is commonly used to describe signs and symptoms that continue or develop after acute COVID-19 (up to four weeks from the initial infection); however, some definitions consider long COVID to be ongoing symptoms from 12 weeks onwards.. Symptoms may last for weeks or months after the acute illness. The presence of lingering symptoms may have a significant impact on the daily lives of those who are affected, their family and whānau. Given the numbers of people who have been or will be infected with SARS-CoV-2 worldwide, the public health impact of long COVID could be significant.

Across the international literature, long COVID may be referred to by many names, including long COVID, post-COVID-19 syndrome, long-haul COVID, post-acute COVID-19, post-acute sequelae of SARS CoV-2 infection, long-term effects of COVID, and chronic COVID.

There is no internationally agreed definition of the long COVID condition yet.

Aotearoa New Zealand will have a unique long COVID profile due to the early successes in transmission reduction in the pandemic. The low prevalence of COVID-19 in Aotearoa New Zealand prior to Omicron has resulted in a proportionally low incidence of long COVID prior to 2022. However, with the arrival of Omicron and Aotearoa New Zealand now having had nearly 1.3 million confirmed cases of COVID-19, an increase in long COVID cases are expected to be seen.

It has been identified that it is clinically important to establish a clear and standardised definition for long COVID in Aotearoa New Zealand. This is will lead to more consistent data collection, analysis, and reporting which is essential for an accurate estimate of the prevalence of long COVID in the population and to allow a better understanding of the impacts of long COVID in Aotearoa New Zealand.

The Ministry of Health has received recommendations from the Long COVID Expert Advisory Group and agreed to adopt a consistent clinical case definition for long COVID to use in Aotearoa. This includes the following recommendations that:

- the definition is specific and provides exact timeframes that differentiate between ongoing systematic COVID-19 and long COVID; and,
- allows for inclusion in the diagnosis irrespective of COVID-19 test result, allows treatment for people who may have had a false negative result, were unable to access testing, and/or have a test conducted.

It has been agreed to adopt the clinical case definitions from the joint guideline used by the National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and the Royal College of General Practitioners (RCGP) to distinguish between ongoing COVID and long COVID cases.

This definition is as follows:

- Acute COVID 19: Signs and symptoms for up to 4 weeks
- Ongoing symptomatic COVID-19: Signs and symptoms of COVID-19 from 4 weeks up to 12 weeks.

- Post-COVID-19 syndrome:
    - signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis. It usually presents with clusters of symptoms, often overlapping, which can fluctuate and change over time and can affect any system in the body
    - post-COVID-19 Syndrome may be considered before 12 weeks while the possibility of an alternative underlying disease is also being assessed
    - in addition to the clinical case definitions, the term 'long COVID' is commonly used to describe the signs and symptoms that continue or develop after acute COVID-19. It includes both ongoing symptomatic COVID-10 (from 4 to 12 weeks) and post-COVID-19 syndrome (12 weeks or more).(6)

Other widely used international definitions include those from the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC), as defined below.

The WHO published the following clinical case definition (created by Delphi consensus) in October 2021:

> "Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis.
>
> Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others which generally have an impact on everyday functioning.
>
> Symptoms may be new onset, following initial recovery from an acute COVID-19 episode, or persist from the initial illness. Symptoms may also fluctuate or relapse over time. A separate definition may be applicable for children."

The CDC in the US uses the term 'post-COVID conditions' to describe long COVID, defined as a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19.

Symptoms and Signs

There are **a range of signs and symptoms** that have been associated with long COVID. Signs and symptoms can vary greatly, and one systematic review and meta-analysis completed in early 2021 found 55 long-term effects noted across 15 studies.(7) Another review, conducted in November 2021, looked at 50 studies and found that more than 100 persistent symptoms were reported.(8) Symptoms can be respiratory, cardiopulmonary, neurological, or generalised, as it detailed in Table 1 below.(9)

Table 1: Commonly reported symptoms of long COVID

Cardiopulmonary	Generalised symptoms
• Difficulty breathing or shortness of breath • Cough • Chest pain, tightness, or heaviness [1] • Palpitations	• Fatigue • Fever • Pain • Reduced exercise capacity

[1] Clinical assessment is required to investigate the specific cause

Neurological • Cognitive impairment ('brain fog', loss of concentration or memory issues) • Headache • Sleep disturbance • Peripheral neuropathy symptoms (pins and needles, numbness) • Ongoing changes to smell or taste • Dizziness • Delirium (in older populations) **Musculoskeletal** • Muscle aches and pains • Muscle weakness[2] • Joint pain **Psychological/ psychiatric symptoms**[3] • Symptoms of depression • Symptoms of anxiety	**Gastrointestinal** • Abdominal pain • Nausea • Diarrhoea • Anorexia and reduced appetite (in older populations) **Ear, nose, and throat** • Tinnitus • Earache • Sore throat • Dizziness **Other** • Skin rashes (including vesicular, maculopapular, urticarial, or chilblain-like lesions on the extremities) • Metallic or bitter taste • Metabolic disruption (such as poor control of diabetes) • Thromboembolic conditions

Some research indicates that people experiencing long COVID tend to fall into one of two symptom groups: those experiencing ongoing respiratory symptoms (including coughing and shortness of breath), combined with fatigue and headaches; and those experiencing multi-systemic symptoms, affecting the heart, brain and gut (for example, palpitations and 'brain fog').(10) A report from the CDC (May, 2022) suggests that people who have had COVID-19 have twice the risk of respiratory conditions or developing pulmonary embolism than those who have not had COVID-19. Furthermore, respiratory conditions had the highest risk ratios reported of conditions associated with long COVID.(11)

In addition to the wide range of possible symptoms, some of the key features of long COVID include:

- Concurrence of multisystem, fluctuating and often overlapping 'clusters' of symptoms
- Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses
- Symptom severity may range from mild to incapacitating
- Worsening of symptoms after physical or mental activity
- Relapses may occur in an irregular pattern or in response to specific triggers (e.g., physical, or mental activity, stress, menstruation, heat, or alcohol)

[2] Muscle weakness can be a reported symptom, and may also be clinically measured
[3] The WHO has noted that the association between long COVID and psychiatric disorders is likely bidirectional

- People may experience new symptoms that were not present during the acute phase of their COVID-19 infection. (1, 3, 5)

The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms. One meta-analysis concluded that the effects largely corresponded with clinical symptoms including fatigue (58%), headache (44%), attention disorder or cognitive impairment/brain fogginess (27%), hair loss (25%) and dyspnea (24%) (shortness of breath).(7)

Neurological symptoms, including persistent cognitive impairment, appear to be affecting as many as one-in-four people recovered from COVID-19.(12) COVID-associated cognitive impairment often includes impaired function relating to concentration, processing information speed, attention and memory.(12) In an investigation of the mechanisms leading to this, a study led by the Stanford University School of Medicine found that even mild cases of COVID-19 could lead to prominent neuroinflammation (or more specifically, brain inflammation). This causes physical damage to the white matter in the brain that resembles damage seen after cancer chemotherapy, including disruption to the same cell types and processes.(13) This damage appears to contribute to the lingering neurological symptom (often termed 'brain-fog') reported by many with long COVID or undergoing chemotherapy. One positive from this association is that cancer therapy related treatments could provide insight into appropriate treatments for long COVID-induced neurological symptoms.(13)

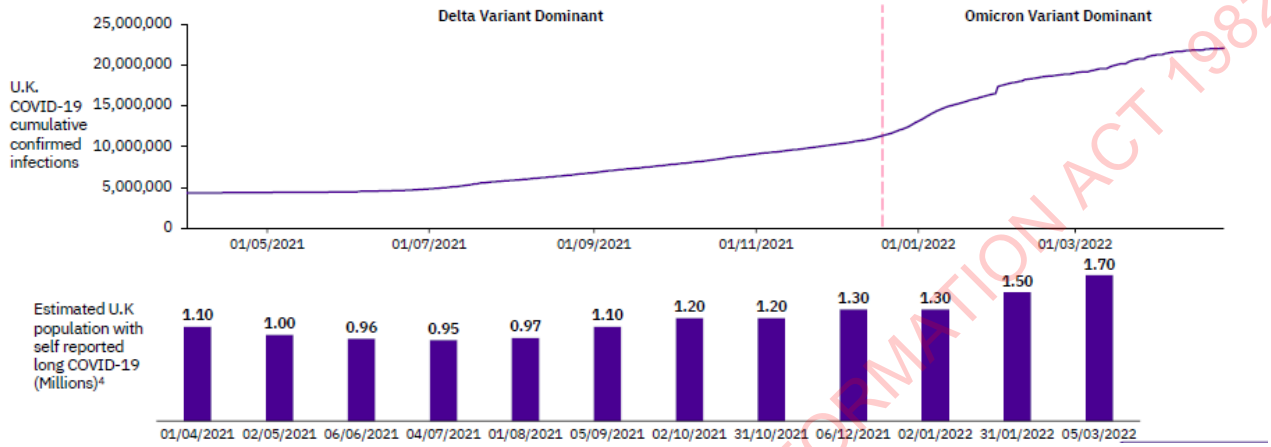
Another study found COVID-19 infections lead to persistent cardio-renal inflammation and activation of the haemostatic pathways which have implications to lung function. The impacts on multisystem injury pathways during SARS-CoV-2 infection could be considered to inform clinical guidelines in preventative measures for long COVID and support measures targeting preventative therapies.(14)

A systematic review and meta-analysis published in mid-April 2022 found over 60 physical and psychological signs and symptoms with wide variation in prevalence estimates reported across 39 studies, although, notably, most studies had a high or moderate risk of bias. The most reported symptoms were weakness (41%; 95% CI 25% to 59%), general malaise (33%; 95% CI 15% to 57%), fatigue (31%; 95% CI 24% to 39%), concentration impairment (26%; 95% CI 21% to 32%) and breathlessness (25%; 95% CI 18% to 34%). Thirty-seven percent (95% CI 18% to 60%) of patients reported reduced quality of life and 26% (10/39) of the studies presented evidence of reduced pulmonary function.(15) In May 2022 the CDC reported that in people with previous COVID-19 diagnosis, one in five individuals between 18-64 years reported at least one incidence of 26 conditions attributed to long COVID. This was even more common in people over 65 years, with one in four.(11)

There is limited evidence on any association between how symptom presentation of long COVID may differ between variants of SARS-CoV-2, and this could be confounded by a variety of factors such as the vaccination rollout, changes in treatment, as well as changes in detection and testing capacities and levels of community prevalence. With the high rates of community transmission of Omicron, and increased asymptomatic transmission, there is less detection of Omicron occurring, compounded by the shift to relying on rapid antigen tests. One early observational study found the Alpha variant was more likely to cause persistent cognitive symptoms when compared to the original Wuhan variant, though these could have been influenced by a range of causes. In this same study the Alpha variant appeared less likely to cause impaired hearing or a loss of sense of smell compared with the original variant.(16)

Omicron

There is limited data available on Omicron, however initial evidence from the UK's Office for National Statistics (ONS) suggests that despite lower case severity with Omicron, these variants are still presenting a significant long COVID burden, which appears to be largely driven by the higher number of cases.(link, visualisation by Airfinity)



The UK's ONS conducted a study using self-reported data from COVID-19 cases to explore the impact of Omicron BA.1 or BA.2 variants on long COVID. The data suggested that:

a) For vaccine boosted adults, there was not statistically significant difference in the risk of self-reported long COVID between first infections with the Delta variant and with either Omicron BA.1 or Omicron BA.2.
b) For boosted adults, the odds of reporting long COVID symptoms four to eight weeks after infection were 21.8% higher after Omicron BA.2 than Omicron BA.1.
c) For those with only a vaccine primary course of two doses, the survey found that the odds of reporting long COVID symptoms after infection were 49.7% lower in Omicron B.A1 infections than the Delta variant.

A new study (June, 2022) has found that the risk of ongoing symptoms or long COVID after Omicron infection is approximately half of the risk after Delta infection.(17) In this UK based case-control study, the odds of symptoms 4 weeks or more post-infection (as per NICE definition) were compared in patients with Omicron (n=56,003 people, 55% female, mean age 53 years) and Delta (n=41,361, 59% female, mean age 53 years). In the Delta-infected cohort, 10.8% experienced ongoing symptoms compared to 4.5% in the Omicron cohort. Although the percentage of Omicron infections leading to long COVID were lower, the absolute numbers are still expected to be greater than for Delta due to the increased numbers that were infected by Omicron, and therefore the impact on the health system could still be significant. The study was unable to estimate the incidence of ongoing symptoms or long COVID in children nor did it compare vaccination statuses.(17)

Long COVID in children

Long COVID in children is not well described, and the studies to date have generally been of poor quality, with some major limitations (such as a lack of a clear case definition, arbitrary follow up time points, subjective assessment, lack of control groups, and low response rates).(18, 19) Evidence is predominantly

limited to select populations without control groups.(20) Relatively few studies have focused on SARS-CoV-2 infection sequelae in children and adolescents, and large, harmonised longitudinal studies are needed.(21) Persistent illness in children has been noted in some studies and in patient support groups, but its prevalence, characteristics and duration are unclear.(22, 23)

Estimates of the prevalence of long COVID in children vary widely.(19) The variability in prevalence estimates could be due to a range of factors, such as initial SARS-CoV-2 infection severity, different methodological approaches (clinical assessment vs self-report), definition of cases (diagnosed vs suspected), variable follow-up times, and prevalence of pre-existing clinical conditions.(20) In the US, a large long-term study of the impacts of COVID-19 on children has recently begun. It will track up to 1,000 children and young adults and evaluate the impacts on their physical and mental health over three years.(21) Some studies suggest that long COVID in children is less common and tends to be less protracted than in adults.(24) Other experts argue that accurately establishing how many children and adolescents suffer from long COVID is difficult and likely underestimated. This may be because acute SARS-CoV-2 infection is less severe in children, often making an initial diagnosis less likely. One report suggests that over half the children and adolescents reported psychological and physical symptoms related to long COVID, irrespective of whether they received a positive SARS-CoV-2 diagnosis or not, though this is difficult to interpret and highlights the impact of the pandemic on children and adolescents.(25)

There is some emerging evidence that signs and symptoms or **clinical presentation may differ for children**, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults. The NICE panel noted that common presentation in children is a lack of concentration, short-term memory loss, and/or difficult doing everyday tasks ≥4 weeks after acute COVID-19 illness.

Some of the studies of long COVID in children include:

- A review of studies of long COVID in children and adolescents identified 14 heterogeneous studies (4 cross-sectional, 10 prospective cohort) investigating long COVID symptoms in a total of 19,426 children and adolescents. The prevalence of long COVID symptoms varied from 4% to 66%, and there was also large variation in the reported frequency of different symptoms. Zimmerman et al (2021) note that all the studies in their review were likely to have been conducted before the Delta variant became dominant, which may have a different risk of long COVID.(19)
- A recent pre-print describes a German study of 157,134 individuals (11,950 children/adolescents and 145,184 adults) with confirmed COVID-19.(26) The COVID-19 and control cohorts were well-balanced regarding covariates. For all adverse health outcomes combined, incidence rates (IRs) in the COVID-19 cohort were significantly higher than those in the control cohort in both children/adolescents. Incidence rate ratio (IRR) estimates were similar for the age groups 0-11 and 12-17. Incidence rates in children/adolescents were consistently lower than those in adults. Among the specific outcomes with the highest IRR and an incidence rate of at least 1/100 person-years in the COVID-19 cohort in children and adolescents were malaise/fatigue/exhaustion, cough, and throat/chest pain.
- The UK Office of National Statistics found that 9.8% of children aged 2-11 years and 13% aged 12-16 years reported at least one ongoing symptom five weeks after a positive diagnosis, whereas 25% of adults aged 35-69-years had symptoms five weeks after a positive diagnosis.(27, 28)
- A paper describing data from the UK COVID Symptom Study (a citizen science project with data collected via an app, which has some associated limitations) found that of 1,734 children aged 5-17 years who were symptomatic at the time of their positive test and reported symptoms regularly for

at least 28 days, 4.4% had an illness duration of at least 28 days.(22) Ongoing symptoms for at least 28 days was less common in younger children aged 5-11 years (3.1%, p=0.046). Over 98% of 1,379 children had recovered by 56 days.(22) However, there may be some bias as using apps is likely to select participants from higher socio-economic background, who have a lower risk of poor outcomes.(19)

- One of the earliest studies on long COVID in children (a cross-sectional study of 129 children in Italy who were diagnosed with COVID-19 between March and November 2020) reported that 42.6% of children surveyed had one or more symptoms >60 days post infection.(29) This included children with mild or asymptomatic initial infection.
- A cohort study of 136 children (most of whom had mild or asymptomatic COVID-19) in Melbourne in 2020 observed that 8% of children had post-acute symptoms. They found that full recovery occurred within weeks of acute symptom onset and reported symptoms were mild in severity but noted this was a young cohort (median age three years).(24)
- A national, cross sectional study in Denmark has investigated the prevalence of ongoing symptoms of long COVID symptoms in children (0-14 years). It found that compared with controls, older children suffering from long COVID had a worse quality-of-life scores relating to social and emotional functioning.(30) However, this study also has found that long-lasting symptoms associated with COVID-19 occurred frequently in children, regardless of whether they had a SARS-CoV-2 infection or not. This is an import observation as it outlines that symptoms in children come and go frequently and although they can persist for months they may not have an obvious cause.(30)
- A national cohort study using data from the Public Health England database looked at adolescents aged 11 to 17 years who tested positive between January and March 2021, who were then matched by month of test, age, sex, and geographical region to adolescents who tested negative. Three months after testing, 2038 (66.5%) who tested positive and 1993 (53.3%) who tested negative had any symptoms, and 928 (30.3%) from the test-positive group and 603 (16.2%) from the test-negative group had three or more symptoms. At 3 months after testing, the most common symptoms among the test-positive group were tiredness (1196 [39.0%]), headache (710 [23.2%]), and shortness of breath (717 [23.4%]), and among the test-negative group were tiredness (911 [24.4%]), headache (530 [14.2%]), and other (unspecified; 590 [15.8%]). Overall the study concluded that adolescents who tested positive for SARS-CoV-2 had similar symptoms to those who tested negative, but had a higher prevalence of single and, particularly, multiple symptoms at the time of PCR testing and 3 months later.(31)

Long-term SARS-CoV-2 infection–associated symptoms can be difficult to distinguish from pandemic-associated symptoms.(18, 19) Some studies have found that children who tested negative for COVID-19 have had similar symptoms, which are common after other viral infections, and could also be due to the experience of lockdown and other social restrictions.(32, 33) Given that acute COVID-19 generally poses a low risk to children, an accurate determination of the risk of long COVID is important in the debate about the risks and benefits of vaccination in this age group.(19) Similar to adults, it is likely that long COVID in children may have a greater impact on those from socioeconomically disadvantaged areas and ethnic minority groups.(21)

In summary, “the relative scarcity of studies of long COVID and the limitations of those reported to date mean the true incidence of this syndrome in children and adolescents remains uncertain. The impact of

age, disease severity and duration, virus strain, and other factors on the risk of long COVID in this age group also remains to be determined."(19) However, even if the proportion of children experiencing post-acute impacts is relatively low, if transmission is widespread (as has been with Omicron), then the impact of persisting symptoms will be considerable.

Epidemiology

Prevalence and incidence

Preliminary results from the Ngā Kawekawe o mate korona study found that in 65 Māori participants, 43% (28 participants) reported symptoms for more than one month, and of these participants, 75% (21 participants) reported experiencing long COVID symptoms for more than three months post-infection. In comparison, of the 405 participants who were non-Māori, 47% (190) reported symptoms for more than one month, and of these individuals, 65% (124) reported symptoms which lasted more than 3 months (link). While similar proportions reported ongoing symptoms, slightly more Māori participants therefore reported symptoms for three months or longer, which is considered long COVID.

The prevalence of long COVID is difficult to establish for a range of reasons, including:(7, 34, 35)

- Studies of long COVID have used different measurement criteria and different inclusion criteria, so they cannot be reliably compared. Studies also often differ in the way they collect data.
- Studies have focused on different groups of people, different symptoms, and time intervals, and used different sample sizes.
- Most studies report the frequency of at least one symptom (not necessarily the same symptom), rather than a cluster of symptoms.
- Published studies may not be representative of everyone who has long COVID, especially with individuals of different cultures and ethnicities considered within samples. New Zealand specific samples need to include Māori, Pacific peoples, people with disabilities, older adults and those living in remote and rural communities.
- Difficulties in accessing COVID-19 testing in different countries may mask the true number of long COVID cases if studies require testing confirmation of the initial infection. In addition, testing policies vary between countries.
- The ways in which responses are elicited can impact estimated prevalence (e.g., app users are self-selected and responsible for recording symptoms, which can result in sampling and recording biases). In addition, many studies use retrospective self-reported symptoms.
- Some tools validated for other diseases may not be appropriate for use in long COVID patients.
- The prevalence of long COVID may also vary greatly depending on the groups studied (for example, app users vs population studies vs studies of patients who were hospitalised).
- The definition of long COVID currently is linked to over 200+ symptoms,(36) therefore studies must have sufficiently large populations to be representative of the range of long COVID symptoms. Otherwise, it is unlikely that estimates of prevalence and incidence will be accurate (link).

- The method of diagnosis of long COVID in national databases also currently appears to rely on self-classification and self-reporting.
- Despite these limitations, there is increasing evidence that a significant proportion of people experience long COVID, and there are concerns that these long term effects may occur on a scale that "could overwhelm existing health care capacity, particularly in low- and middle-income countries."(16)

Please see the below table for an overview of prevalence estimates from some key sources, systematic reviews, and meta-analyses.

Paper	Population / Aim/ Number of studies	Key findings
Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 1 June 2022. The Office for National Statistics UK.	2 million people (self-reported)	An estimated 2million people living in private households in the UK (3.1 % of the population) were experiencing self-reported long COVID (symptoms persisting for more than four weeks after the first suspected coronavirus infection that were not explained by something else) as of 1 May 2022. This figure is based on symptoms and not a clinical diagnosis, and only 1.4 million (72%) had had COVID-19 at least 12 weeks previously.
A systematic review and meta-analysis published in mid-April 2022(37): Chen, C., et al., *Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review.* The Journal of Infectious Diseases, 2022.	50 studies were included and 41 were part of the meta-analysis.	As of 16 April 2022, the global estimated pooled prevalence of post COVID-19 condition was 0.43 (95% CI: 0.39,0.46), or 200 million individuals. - Regional prevalence estimates were Asia— 0.51 (95% CI: 0.37,0.65), Europe— 0.44 (95% CI: 0.32,0.56), and North America— 0.31 (95% CI: 0.21,0.43). -Global prevalence for 30, 60, 90, and 120 days after infection were estimated to be 0.37 (95% CI: 0.26,0.49), 0.25 (95% CI: 0.15,0.38), 0.32 (95% CI: 0.14,0.57) and 0.49 (95% CI: 0.40,0.59), respectively. -Hospitalised and non-hospitalised patients had estimates of 0.54 (95% CI: 0.44,0.63) and 0.34 (95% CI: 0.25,0.46), respectively. - Denmark has the highest estimate of Long COVID-19 per 100,000 people (defined in this case as at least one symptom of COVID-19 up to 120 days after infection), with 23,558, followed by Andorra (23,329), and Israel (23,194). -The United States has the highest absolute number of Long COVID-19 cases, with 25,141,186, followed by India (22,824,713), and France (12,526,469).
Systematic review and meta-analysis published in August 2021 (7): Lopez-Leon, S., et al., *More than 50 long-term effects of COVID-19: a systematic review and meta-analysis.* Scientific		Estimated that the number of people with SARS-CoV-2 who developed one or more long-term symptoms could be as high as 80% of patients.

Paper	Population / Aim/ Number of studies	Key findings
Reports, 2021. **11**(1): p. 16144.		
October 2021 systematic review (16): Groff, D., et al., *Short-term and Long-term Rates of Post-acute Sequelae of SARS-CoV-2 Infection: A Systematic Review.* JAMA Network Open, 2021. **4**(10): p. e2128568-e2128568.	The mean age was 54.4 years, and 79% were hospitalised during acute COVID-19. High-income countries contributed 79% of the studies.	The median (IQR) proportion of COVID-19 survivors experiencing at least 1 post-acute sequelae of COVID-19 (PASC) was 54.0% (45.0%-69.0%; 13 studies) at 1 month (short-term), 55.0% (34.8%-65.5%; 38 studies) at 2 to 5 months (intermediate-term), and 54.0% (31.0%-67.0%; 9 studies) at 6 or more months (long-term). That is, more than half of COVID-19 survivors experienced PASC 6 months after recovery.
Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ (2021) Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLoS Med 18(9): e1003773. (38)	A retrospective cohort study based on linked electronic health records (EHRs) data from 81 million patients including 273,618 COVID-19 survivors.	Among COVID-19 survivors (mean [SD] age: 46.3 [19.8], 55.6% female), 57.00% had one or more long-COVID feature recorded during the whole 6-month period (i.e., including the acute phase), and 36.55% between 3 and 6 months. Findings showed that the highest prevalence is in Asia, followed by Europe and North America. The data is limited due to being self-reported with the studies definitions of long COVID varying from 4 to 12 weeks.
Long COVID: Household Pulse Survey. CDC	US Census Bureau survey	40% of the total adult population has contracted COVID-19, and from this population, the estimated prevalence of long COVID (ongoing symptoms for three months or longer) is 1 in 5 adults.
Zeng, N., Zhao, YM., Yan, W. et al. A systematic review and meta-analysis of long term physical and mental sequelae of COVID-19 pandemic: call for research priority and action. Mol Psychiatry (2022).(39)	A meta-analysis of survivors' health consequences and sequelae for COVID-19. A total of 151 studies were included involving 1,285,407 participants from thirty-two countries.	At least one sequelae symptom occurred in 50.1% (95% CI 45.4-54.8) of COVID-19 survivors for up to 12 months after infection. The most common investigation findings included abnormalities on lung CT (56.9%, 95% CI 46.2–67.3) and abnormal pulmonary function tests (45.6%, 95% CI 36.3–55.0), followed by generalised symptoms, such as fatigue (28.7%, 95% CI 21.0–37.0), psychiatric symptoms (19.7%, 95% CI 16.1–23.6) mainly depression (18.3%, 95% CI 13.3–23.8) and PTSD (17.9%, 95% CI 11.6–25.3), and neurological

Paper	Population / Aim/ Number of studies	Key findings
https://doi.org/10.1038/s41380-022-01614-7		symptoms (18.7%, 95% CI 16.2–21.4), such as cognitive deficits (19.7%, 95% CI 8.8–33.4) and memory impairment (17.5%, 95% CI 8.1–29.6). The findings suggest that after recovery from acute COVID-19, half of survivors still have a high burden of either physical or mental sequelae up to at least 12 months.
A global systematic analysis of the occurrence, severity, and recovery pattern of long COVID in 2020 and 2021 (40) https://doi.org/10.1101/2022.05.26.22275532	10 ongoing cohort studies in 10 countries. They pooled data from the contributing studies, two large medical record databases in the United States, and findings from 44 published studies using a Bayesian meta-regression tool. Analyses are based on detailed information for 1906 community infections and 10526 hospitalized patients from the ten collaborating cohorts, three of which included children.	Globally, in 2020 and 2021, 144.7 million (95% uncertainty interval [UI] 54.8–312.9) people suffered from any of the three symptom clusters of long COVID. This corresponds to 3.69% (1.38–7.96) of all infections. The fatigue, respiratory, and cognitive clusters occurred in 51.0% (16.9–92.4), 60.4% (18.9–89.1), and 35.4% (9.4–75.1) of long COVID cases, respectively. Those with milder acute COVID-19 cases had a quicker estimated recovery (median duration 3.99 months [IQR 3.84–4.20]) than those admitted for the acute infection (median duration 8.84 months [IQR 8.10–9.78]). At twelve months, 15.1% (10.3–21.1) continued to experience long COVID symptoms.

Aetiology

Long COVID is complex and there is likely to be more than one mechanism that contributes to its development. Evidence continues to emerge on the molecular contributors to long COVID, which may inform advice for management and treatment.

A range of factors have been suggested to contribute to the development of long COVID, including effects of the virus on the body (particularly on the nervous system and vascular system); the possibility of virus fragments lingering in the body triggering ongoing symptoms; or the immune system becoming overactive in response to COVID-19. The current four main theories suggest possible causes may be: (link)

1) persistent virus or viral antigens causing chronic inflammation
2) autoimmunity triggered by infection

3) dysbiosis and viral reactivation

4) unrepaired tissue damage

A preliminary study performed in hamsters found that severe acute SARS-CoV 2 infection resulted in pathologies leading to long COVID. The study found when compared to Influenza A, SARS-CoV-2 had a greater likelihood to permanently damage the lungs and kidneys and impacted both the olfactory bulb and epithelium of the hamsters. A month after viral clearance, within the olfactory bulb and epithelium there was activation of T-cells and myeloid cells, production of proinflammatory cytokines and interferon responses. These responses were correlated to behavioural changes including increased compulsive behaviours and anxiety.(41) From these results we can infer it is likely that acute SARS-CoV 2 infection has the potential to cause widespread cellular damage which is linked to onset of long COVID. However, the link between the severity of symptoms, degree of cellular damage and impact this has on risk of developing long COVID will require further research.

More research is needed to better understand the potential immunological mechanisms contributing to the development of long COVID. Some people with long COVID are experiencing similar symptoms to myalgic encephalomyelitis / chronic fatigue syndrome (ME/CFS) and after other viral infections such as SARs-CoV-1 and MERS.(42) There is a similar pattern of long-term illness being triggered by acute infection by these viruses in some people.(43) Current research suggests that cellular damage and inflammation from these viral infections is linked to long COVID symptoms. There is continued research underway to investigate how long COVID may be related to other post-viral conditions.

Risk Factors

There is a growing body of evidence about which groups are at greatest risk of developing persistent symptoms.

Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Even people who initially had no symptoms may go on to develop long COVID.(44) Long COVID is seen in all age groups, however, it appears to be less common in children and adolescents than in adults.

Some factors that may be associated with increased chance of having long COVID symptoms have been identified, and these include:

- older age (4, 10, 45) (link)
- having more than one underlying chronic medical condition or pre-existing conditions
- a higher body mass index (obesity) (45)
- being female (45-47)(link)
- hospitalisation during acute COVID-19 (48)
- multiple early symptoms (49, 50)
- SARS-CoV 2 variant type.(17)

In the UK's Coronavirus (COVID-19) Infection Survey, prevalence of self-reported long COVID was greatest in people aged 35 to 49 years, females, people living in more deprived areas, those working in social care,

teaching and education or health care, and those with another activity-limiting health condition or disability. Notably, this was self-reported rather than from clinical diagnosis.(link)

Other factors that may immunologically predispose people to a greater risk of long COVID have been noted,(49) and these include having a greater viral load during early stages of infection, the presence of autoantibodies, (51) imbalances or compositional alterations in gut microbiome,(51, 52) and vaccination status.(53) Previous Epstein-Barr infection or a reactivation of latent viruses during initial infection has also been noted.(51, 54)

Recent studies have found that there is a correlation between COVID-19 variant type and the risk of developing long COVID. A UK based study published in June has indicated that the risk of developing long COVID from Omicron (4.4%) is roughly half the risk from Delta infections (10.8%).(17) These studies do however note the risk of developing long COVID still remains of significant concern as the rising Omicron incidence rates indicate that the absolute numbers of people with long COVID will be large, and therefore a burden on the health system.

Prevention

Much of the discussion on prevention of long COVID currently focuses on the role of vaccination. Collectively, findings from various early studies suggest that **vaccination against COVID-19 might reduce the population prevalence of long COVID** by reducing the risk of: (a) continuing to experience persistent symptoms in those who already have symptoms when vaccinated; (b) developing persistent symptoms after breakthrough infections; (c) being infected in the first place; and (d) transmitting the virus after infection.(55) However, vaccination before infection likely confers only partial protection against development of long COVID, and so reliance on it as a sole mitigation strategy may not optimally reduce long-term health consequences of SARS-CoV-2 infection.(48)

Vaccination

The effectiveness of vaccination against long COVID is an important area of research, but significant uncertainties remain. Much of the evidence to date points to some protective effect of vaccination. However, the lack of randomised controlled trials and predominance of observational studies mean that causality cannot be easily determined (55) and it is difficult to truly know the effect of vaccination. A BMJ editorial published in May 2022 notes that benefits of vaccination against long COVID are possible, but more evidence is needed, along with a mechanism of action.(56) Early research suggests that long COVID symptoms are less common following breakthrough infections, but the effectiveness of vaccination on pre-existing long COVID is less clear.(55)

A key resource on the topic at this time is a review by the UK Health Security Agency (UKHSA), which was published in February 2022.(57) The review included 15 observational studies published up until mid-January 2022. Overall, the review indicated that people who have had one or more doses of a COVID-19 vaccine are less likely to develop long COVID than those who remain unvaccinated.(58) However, as all of the studies were observational, it is possible that differences other than vaccination may contribute to the results. In addition, the definition of long COVID varied between studies.(59)

In Aoteaora New Zealand, Māori may have an increased risk of developing long COVID given the higher rates of COVID-19 in this group, and lower vaccination rates. The potential inequitable impact of long COVID on Māori is concerning and is receiving recent media attention (link).

The impact of vaccination prior to infection on long COVID

UKHSA collated evidence from eight studies which investigated the effectiveness of vaccination against long COVID prior to infection.(57) Findings from six of the eight studies suggested that vaccinated people (those who have had one or two doses) were less likely to develop symptoms of long COVID following infection compared with unvaccinated people.(59) This was seen in short (4 weeks), medium (12-20 weeks), and long (6 months) term timeframes after infection. In two of the eight studies, participants that were fully vaccinated were less likely to report the following symptoms in the medium to long term: fatigue, persistent muscle pain, headache, hair loss, weakness in arms and legs, shortness of breath, dizziness, anosmia, interstitial lung disease, myalgia and other pain.(57) As all eight of the studies only included participants who had COVID-19, the effect of vaccination on reduced incidence of COVID-19 is not accounted for. Therefore the studies likely underestimate the effectiveness of vaccines to prevent long COVID.

A UK nested case-control study(53) included in the UKHSA review (deemed medium quality) found that fully vaccinated participants were approximately half as likely to have symptoms lasting at least 28 days as unvaccinated participants.(59) However, no statistically significant benefit was found for those who were partially vaccinated compared to those who were unvaccinated. The UK Office for National Statistics reported similar results in January 2022 (based on data to 30 Novemeber 2021). In a sample of UK adults aged 18-69 years, receiving two doses of a COVID-19 vaccine was associated with a 41.1% decrese in the odds of self reported long COVID at least 12 weeks later (compared to socio-demographically similar study participants who were not vaccinated when infected).

There continues to be no data in children about the level of protection provided by vaccination against the incidence of long COVID (in addition to protection against infection) in those who have become infected after vaccination.

The impact of vaccination after infection on long COVID

It is widely recommended that after a COVID-19 infection, people should start or continue their vaccination schedule after 3 months from diagnosis with the acute illness, to allow for some time for recovery.

The effect of vaccination on pre-existing long COVID remains uncertain and contentious, as published studies have generally been small and with self-selected participants.(56) Anecdotal reports and some studies (57, 60) suggest a range of experiences following COVID-19 vaccination ranging from improvement, deterioration, and no change in long COVID symptoms. In the UKHSA review, 3 of 4 studies comparing long COVID symptoms before and after vaccination suggested that more cases reported an improvement in symptoms after vaccination, either immediately or over several weeks.(57) However, some cases in all studies did report a worsening in symptoms after vaccination.(57) In three of the five studies reporting on symptom changes following vaccination of people with long COVID, there was a higher proportion of people with long COVID who reported unchanged symptoms following vaccination (up to 70%) than people whose symptoms improved or worsened.(57)

Some studies have suggested that vaccination after infection can significantly reduce the likelihood of long COVID. For example, a large study which analysed self-reported data from 1.2 million UK smartphone users found that two doses of a COVID-19 vaccine halved the risk of long COVID.(53) However, some recently published studies suggest that the protective effect may not be as great as initially thought.(61)

A large study published in *Nature Medicine* in May 2022 used the US Veterans Affairs databases for an analysis that included more than 13 million people.(48) This also suggested a more limited protective effect, finding that vaccination lowers the risk of long COVID after infection by about 15%.(61) Symptoms such as brain fog and fatigue were compared in vaccinated and unvaccinated participants for up to six months after they tested positive for SARS-CoV-2. No difference was found in the type or severity of symptoms between vaccinated and unvaccinated groups.

The UKHSA rapid evidence briefing also reported on 3 studies which compared people with long COVID who were infected with SARS-CoV-2 and then subsequently vaccinated, to participants with long COVID that remained unvaccinated following infection. All three studies reported that **the cohort who received the vaccinations were significantly less likely to experience long COVID symptoms shortly after vaccination and over longer periods**.(57)

One of the largest studies on this topic to date (published May 2022) is a community-based cohort study of 28,356 participants (mean age 46 years, 56% female, 89% white) from the UK's COVID-19 Infection Survey examined the trajectory of long COVID symptoms following COVID-19 vaccination. Participants were aged 18 to 69 years who received at least their first vaccination after test-confirmed infection. The study had a median follow-up of 141 days from first vaccination (among all participants) and 67 days from second vaccination (84% of participants). The principal finding was a decrease in the likelihood of experiencing long COVID symptoms after a second vaccine dose. First vaccination was associated with an initial 12.8% decrease (95%CI: −18.6% to −6.6%) in the odds of long COVID but increasing by 0.3% (−0.6% to +1.2%) per week after the first dose. Second vaccination was associated with an 8.8% decrease (−14.1% to −3.1%) in the odds of long COVID, with the odds subsequently decreasing by 0.8% (−1.2% to −0.4%) per week. There was no statistical evidence of heterogeneity in associations between vaccination and long COVID by socio-demographic characteristics, health status, whether hospitalised with acute COVID-19, vaccine type (adenovirus vector or mRNA), or duration from infection to vaccination.(55)

As part of a federated research study with the COVID-19 Patient Recovery Alliance, Arcadia Data Research (Arcadia.io) performed a retrospective analysis of the medical history of 240,648 COVID-19-infected persons to identity factors influencing the development and progression of long COVID. Data were captured directly from electronic health record (EHR) systems, practice management systems. This analysis revealed that patients who received at least one dose of any of the three COVID vaccines available in the US (Pfizer, Modern or Janssen) prior to their diagnosis with COVID-19 were 7-10 times less likely to report two or more long-COVID symptoms compared to unvaccinated patients. Furthermore, unvaccinated patients who received their first COVID-19 vaccination within four weeks of SARS-CoV-2 infection were 4-6 times less likely to report multiple long-COVID symptoms, and those who received their first dose 4-8 weeks after diagnosis were 3 times less likely to report multiple long COVID symptoms compared to those who remained unvaccinated. The study authors argue that this relationship supports the hypothesis that **COVID-19 vaccination is protective against long COVID and that effect persists even if vaccination occurs up to 12 weeks after COVID-19 diagnosis**.(62)

Additionally, one study assessed the timing of vaccination following COVID diagnosis and concluded that people who were vaccinated sooner were likely to report less long COVID symptoms than unvaccinated people. However, in both vaccinated and unvaccinated people following infection, most people (up to 70%) reported no change to long COVID symptoms after vaccination.(63) The study population were limited to 44 vaccinated patients with 22 matched unvaccinated patients, and therefore larger studies are needed. (63)

A study in the UK surveyed 900 people living with long COVID and evaluated the impact of their first COVID-19 vaccination on their symptoms. In this, 57.9% of people reported an improvement to symptoms, 24.2% no change and 17.9% reported deterioration. The report also stated that people who received mRNA vaccines tended to report larger levels of improvement compared to adenovector vaccines. This is the largest survey to date of people living with long COVID, however due to the self-reporting nature of the survey, it is noted that a randomised controlled trial would be required to confirm any direct links between that observed between vaccination and improvement to long COVID symptoms.(64)

Impacts

Psychosocial impacts

The functional impairment experienced by some people with long COVID and the toll managing symptoms has on quality of life is becoming clearer. An early patient-led study of 3,762 self-described long haulers in 56 countries found 45.2% (42.9% to 47.2%) reported requiring a reduced work schedule compared to pre-illness and 22.3% (20.5% to 24.3%) were not working at the time of the survey due to their health conditions.(36)

Long COVID patients are **reporting multiple psychosocial impacts, including mental health related impacts**. This includes reporting experiences of feeling depressed, anxious, or worried.(65) (65)(64)(63)(63)(65)Another article considering guidance to support patients experiencing long COVID found several specific mental health challenges, including: post-traumatic stress disorder (PTSD), major depressive disorder, anxiety disorders, sleep disorders, phobias, fears with avoidant behaviours, health anxieties, obsessive-compulsive disorder (OCD) and adjustment disorder related to living with long COVID-19 symptoms, social exclusion and addictions (as a form of coping), and neuropsychiatric disorders.(66) In the Ngā Kawekawe o Mate Korona study, 43% of Māori and 52% of non-Māori reported not feeling understood by their healthcare professional, and 61% an 76% respectively reported having concern about not knowing when their symptoms would end (link).

Overall, long COVID is having an impact on reported quality of life. An online survey study completed in 2021 found an overall reduction in quality of life, and this was due to a range of the symptoms reported which included sleep quality, breathlessness, physical activity and mental health.(65)

Social and economic impacts

While the fiscal impacts of the COVID-19 pandemic in general is well known and reported on across jurisdictions, **the fiscal impacts of long COVID specifically are less well known and scarcely reported on, as the impacts are hard to quantify given the wide variety of variables involved**. The impact of long COVID can be looked at from multiple angles: from **decreased productivity due to a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.**

Additionally, **long COVID has had an impact on the ability of some patients to work.** People with ongoing symptomatic COVID-19 or post-COVID-19 syndrome who report increased absence or reduced performance in education or work may need extra support and recovery time.(6) Long COVID therefore limits the ability of people to return to work and to socialise, not only potentially further affecting their mental health, but also having economic consequences for them, their whānau and society.(5)

Preliminary analysis from Ngā Kawekawe o Mate Korona study has found that 45% of Māori with long COVID say their usual activities have been affected to a moderate or extreme level; about 20% have severe pain; and about 10% have difficulty moving (link).

The Solve Long COVID initiative, a non-profit research and advocacy group in the United States, has estimated that the disability caused by long COVID has cost $386 billion dollars in the United States alone. Only the personal financial impact on affected individuals was considered, like lost wages, lost savings, and healthcare costs, from the beginning of the pandemic through to January 31 2022 (link).

Further work to measure the financial impact of long COVID is still required to fully understand its scale. Countries across the globe have committed varying levels of financial resources to diagnose, understand and treat the condition, but research and reporting regarding the overall financial impact and the second and third order financial effects of long COVID is currently scarce.

The social and economic burden of long COVID will affect Māori and Pacific peoples to a greater degree, as they have accounted for a greater proportion of cases during Aotearoa New Zealand's Delta and Omicron outbreaks.

Diagnosis, Treatment, Management and Support

Diagnosis

There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definitions of long COVID (as is detailed above).

Although there are a wide range of symptoms that can present for long COVID, many of these symptoms are common from a multitude of other conditions, making them hard to decipher or confirm as long COVID. Additionally, ongoing symptoms may vary widely and will affect people in diverse ways, and symptoms can be diverse with multiorgan involvement. Long COVID is multi-factorial, and more than one mechanism may be implicated in clinical presentations.(67)

Compounding the lack of clear definitions, due to the relative newness of the condition, there may be a limited amount of knowledge of the condition known by many health care professionals.

There are currently no specific tests to aid in the diagnosis.

Preliminary analysis from the Ngā Kawekawe o Mate Korona study has found many patients have faced a number of helathcare access challenges in their long COVID journey, including:

- 32% of Māori and 49% of non-Māori reporting their doctor did not recommend or provide wraparound support
- 50% of Māori and 40% of non-Māori being unable to get good information about vaccines for people with long COVID
- 35% of Māori and 34% of non-Māori not being referred to a specialist, and 13% of Māori and 4% of non-Māori not having their specialist referral accepted
- 52% of Māori and 37% of non-Māori not knowing who to ask for help or support
- 48% of Māori and 44% of non-Māori not feeling listened to
- 32% of Māori and 43% of non-Māori reporting their doctor did not know what to do next (link).

Models of care

Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient,(5) and an individualised management plan developed.(68) Some patients may find it useful to keep track of their symptoms. Keeping a log of symptoms can help better understand them, identify which symptoms impact them most, and identify patterns and changes in their symptoms.(69) Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID.

Internationally, multidisciplinary teams are working together to tackle the unique symptoms each patient experiences and tailoring treatment to them.(3) Countries are creating dedicated treatment guidelines and care pathways, and the US, UK and Germany have opened post-COVID clinics as one-stop-shops for treatment and support. For example, an Adult Post-Acute COVID clinic at Vanderbilt University brings together specialists from internal medicine, infectious disease, pulmonology, cardiology, ophthalmology, psychology, physical medicine, ear, nose and throat, speech pathology and neurology.(3) Physical therapy, physiotherapy, and occupational therapy have also been key tools used for those struggling with fatigue. Nutritional support has also been important, with lethargy having flow-on effects onto the ability to cook and prepare food, resulting in some struggling with malnutrition.(70)

Specific symptom management will usually be pragmatic, with avoidance of over-investigation.(68, 71)

Currently, there are no collated Aotearoa New Zealand resources for symptom management. The National Institute for Health Innovation has a page on long COVID (link) which directs patients and health professionals to the NHS (National Health Service, UK) COVID recovery website (below) and has symptom-based suggestions to manage long COVID at home.

The NHS, UK based, self-help site Your COVID Recovery has a page explaining long COVID. https://www.yourcovidrecovery.nhs.uk/what-is-covid-19/long-covid/. On this site there are patient resources to help manage many of the commonly experienced symptoms of long COVID including:

- Managing the effects on your body https://www.yourcovidrecovery.nhs.uk/managing-the-effects/effects-on-your-body/
- Managing the effects on your mind https://www.yourcovidrecovery.nhs.uk/managing-the-effects/effects-on-your-mind/
- Your wellbeing https://www.yourcovidrecovery.nhs.uk/your-wellbeing/

Swiss based Altea Long COVID Network is an online site which focuses on the exchange of information about long COVID. Altea is a meeting place for those affected, relatives, medical professionals, researchers, and other interested parties https://www.altea-network.com/en .

In sections such as the Vademecum, Blog and the Directory (of clinics, doctors and therapists), knowledge about aspects of Long COVID should continuously grow and be updated. Altea have committed themselves to the principle of “co-creation”: By including different perspectives, new content and solutions will be created.

For Aotearoa New Zealand, an equity focus with a co-design approach with key affected communities of those living with long COVID, Māori and Pacific peoples is key. Patient and peer support networks have

played a key role in the initial response to long COVID predominantly on social media platforms Facebook and Twitter.

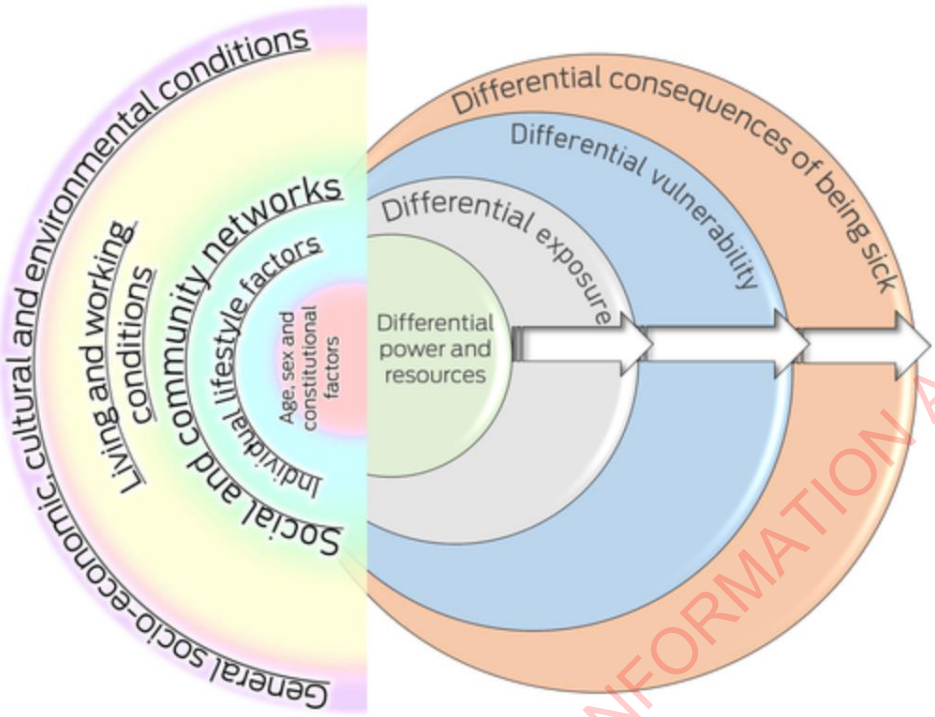
Complementary medicine studies have also been undertaken to understand the role they may have in long COVID management. Fatigue is the most common long-haul symptom among women who have recovered from an acute COVID-19 infection. One randomised, blinded, controlled clinical trial evaluated an essential oil blend for energy boosting effects. Two weeks of twice-daily inhalation resulted in significant improvements to energy levels as compared to a placebo group. Aromatherapy improves energy levels among women who have recovered from COVID-19 but still experience low energy.(72) There is also evidence that Traditional Chinese Medicine (TCM) medications are effective in the symptom management of COVID-19 patients.(73) Conversely, evidence for the effectiveness of most Complementary and Alternative Medicine interventions still needs evaluation.

Rongoā Māori (Māori medicine) where ailments are treated in a holistic manner is also of cultural significance for Aotearoa populations. A scoping review is underway to examining the barriers and facilitators for Māori accessing injury and rehabilitation services, and the findings will be of benefit when considering long COVID rehabilitation for the priority populations affected by long COVID.(74)

International guidelines on rehabilitation and management

Existing international guidelines propose that the initial management of long COVID should be in primary care and should include a series of investigations both to characterise how the individual is affected and to exclude other conditions that may coexist. Management, referrals and care pathways should then be tailored to the manifestations of disease, including investigation and referral for signs of involvement of different organ systems (5). The patient voice has been critical in shaping awareness of long COVID internationally and within New Zealand, and patient- and whānau-centred care should continue to be the focus.

In an article for the Medical Journal of Australia, de Leeuw identifies the effect of long COVID across communities that were already struggling before the pandemic, which will suffer more from infection and from the ongoing cascade of social (eg, work and employment, housing and service access, disability support) and health (exacerbating chronic suffering and comorbid conditions) consequences.(75) The authors have developed a visual representation of Long COVID health inequities. See Figure below.



The Rainbow Model of Social Determinants of Health was adapted from Dahlgren and Whitehead[4] and Diderichsen et al.[5]

References for illustration (76, 77)

Alongside treatment options, support and care services may be needed for people with persistent symptoms. Counselling and psychological support may be needed to address high rates of poor mental health, and many of the post-COVID clinics set up throughout the US and UK contain psychology services or referrals.(78) Psychological supports can also help people with the process of recovery and not just the psychological adjustment. Timely access to good quality information to understand their illness, managing expectations of others, as well as positive contact with people who are or previously been through this illness also assist in an individual's recovery.(79)

There are an increasing number of guidelines available for clinical management of patients with long COVID. Some of these are listed below. These might be useful to consult when developing New Zealand specific guidelines.

Source	Title	Date	Link	Notes
Australian National COVID-19 Clinical Evidence	Australian Guidelines for the clinical care of people with COVID-19:	Living Guidelines last updated 9 May 2022	https://app.magicapp.org/#/guideline/L4Q5An/section/jDJJJQ	Guidance for clinicians on: - Assessing and diagnosing post-COVID conditions - A consensus recommendation of symptoms and signs - Management and care of people with post-COVID-19 condition

	Post COVID-19			
National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and Royal College of General Practitioners (RCGP)	COVID-19 rapid guideline: managing the long-term effects of COVID-19	Version 1.14 published on 01.03.2022	https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-5103551574 2	Guidance for clinicians on: - Identification - Assessment - Investigations and referral - Planning care - Management (including self-management or supported management, multidisciplinary rehabilitation, and additional support) - Follow-up, monitoring, and discharge - Sharing information and continuity of care - Service organisation - Common symptoms - Equality considerations
Centres for Disease Control and Prevention (CDC), USA	Interim Guidance on Evaluating and Caring for Patients with Post-COVID Conditions	June 2021	https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-index.html	Includes guidance on general clinical considerations, patient history and physical examinations, assessment, and testing, management, and public health recommendations. The guidelines argue many post-COVID conditions can be managed by primary care providers, with the incorporation of patient-centred approaches to optimise the quality of life and function in affected patients. Objective laboratory or imaging findings should not be used as the only measure or assessment of a patient's well-being; lack of laboratory or imaging abnormalities does not invalidate the existence, severity, or importance of a patient's symptoms or conditions. Healthcare professionals and patients are encouraged to set achievable goals through shared decision-making and to approach treatment by focusing on specific symptoms (e.g., headache) or conditions (e.g., dysautonomia); a comprehensive management plan focusing on improving physical, mental, and social wellbeing may be helpful for some patients.
BMJ Practice Pointer (71)BMJ Practice Pointer (71)	Management of post-acute COVID-19 in primary care	Aug 2020	https://www.bmj.com/content/370/bmj.m3026	Guidance for the management of people with long COVID in primary care.

Royal Australian College of General Practitioners	Caring for Patients with Post COVID-19 Syndrome	May 2022	https://www.racgp.org.au/getattachment/8c5b3936-5551-4b94-81d4-614e2b69da51/Caring-for-patients-with-post-COVID-19-conditions.aspx	The purpose of this resource is to provide advice and support to GPs and their teams when caring for patients with post–COVID-19 conditions, and to encourage the development of individualised plans for their ongoing management.
Scottish Intercollegiate Guidelines Network (SIGN) (80)Scottish Intercollegiate Guidelines Network (SIGN) (80)	Managing the long-term effects of COVID-19	Dec 2020	https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf	This document covers care for people who have symptoms that develop during or after an infection consistent with COVID-19, continue for more than four weeks and are not explained by an alternative diagnosis. It also provides advice on diagnosis and management based both on the best available evidence and the knowledge and experience of the expert panel.
Ontario Health	Post-COVID-19 Condition: Guidance for Primary Care	Dec 2021	https://www.ontariohealth.ca/sites/ontariohealth/files/2021-12/PostCovidConditionsClinicalGuidance_EN.pdf	This document includes guidance for primary care on: - Assessment - Testing - Diagnosis - Physical examination - Management
Chartered Society of Physiotherapy	COVID-19 Rehabilitation Standards	August 2021	https://www.csp.org.uk/publications/covid-19-community-rehabilitation-physiotherapy-service-delivery	UK guidance for physiotherapy service delivery for adults who are hospitalised due to acute COVID-19 or long COVID

Policy Responses

The full magnitude of the long COVID burden globally is still yet to be known, with countries all at varying stages of their response to COVID-19, with some only having experienced significant outbreaks following the emergence of the Omicron variant, resulting in a lack of first-hand experience in addressing long COVID and undeveloped systems to respond to and report on long COVID.

For an equitable policy response in Aotearoa New Zealand, partnership, and shared decision-making with key affected communities, including those with long COVID, the Māori Health Authority, the Ministry for Pacific Peoples, and the New Ministry for Disabled People.

United Kingdom: The UK government has set up over 80 specialist clinics[i] to provide support to those suffering from long COVID, which provide psychological and physiological support services. Further research funding is being provided through grants to NGOs and healthcare providers through the National institute of health, to date only around 50 million pounds of funding has been provided for research in to Long COVID. The UK government has made Statutory Sick Payments, Universal Credit or Employment and Support Allowance (ESA) available to people if Long COVID affects how much they can work. Affected individuals can also apply for a Personal Independence Payment if they have difficulty with everyday tasks and getting around.[ii] The UK's response has endeavoured to provide all information in accessible and age-appropriate formats so that people can understand and take part in decisions about their care, as guided by the NICE guidelines on shared decision making and good patient experiences.

United States: As of July 2021, long COVID, also known as post-COVID conditions, can be considered a disability under the Americans with Disabilities Act President Joe Biden has directed federal agencies to support patients and doctors by providing science-based best practices for treating long COVID, maintaining access to insurance coverage, and protecting the rights of workers as they try to return to jobs while coping with the uncertainties of the malaise.

France: Since the French government identified Long COVID at the end of the first wave of the virus in spring 2020, it has been watching the issue closely to care for those affected and to better understand the disease. On 17 March 2022, the Health Minister published a statement recognising Long COVID as a health concern in France and acknowledging the necessity for ongoing research into its prevalence, diagnosis, and treatment.

Germany: The German Government has committed to the establishment of a Germany-wide network of 2,580 competence centres and interdisciplinary outpatient clinics to further research and ensure needs-based care around the long-term effects of COVID-19. German physicians dealing with Long COVID have established a dedicated national association, with thirteen specialised working groups, to promote research, share information and improve the treatment of patients suffering from Long COVID.

Sweden: The Swedish government has implemented several responses to Long COVID. It has supported research on COVID-19 through funding to the Swedish Research Council and tasked the Swedish Agency for Health and Care Services Analysis with mapping Long COVID care across the country. The National Board of Health and Welfare has produced guidelines and statistical reports to support the health and welfare system in meeting the needs of Long COVID sufferers. However, the general lack of information about the condition, and awareness of it, as well as the immense pressure on the healthcare system during the pandemic, means that a system for testing and assessment, treatment, and support available to sufferers is not yet fully functioning.

Next Steps	Share with CAHPO
In the development of this work, the following parties have been consulted with:	

Resources used:		
Ministry of Health Policies and Procedures	☒ Yes ☐ No	
External Health Scientific organisations	☐ Yes ☐ No	
Existing database of RFAs	☒ Yes ☐ No	
Internal Ministry of Health Advice	☒ Yes ☐ No	
External Expert Advice	☐ Yes ☐ No	
Literature Review	☒ Yes ☐ No	

1. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188] 2021 [updated 11 November 2021. Available from: https://www.nice.org.uk/guidance/ng188.

2. Leung TYM, Chan AYL, Chan EW, Chan VKY, Chui CSL, Cowling BJ, et al. Short- and potential long-term adverse health outcomes of COVID-19: a rapid review. Emerg Microbes Infect. 2020;9(1):2190-9.

3. National Institute for Health Research. Living with COVID19 2020 [updated 15 October 2020. Available from: https://evidence.nihr.ac.uk/themedreview/living-with-covid19/#Conclusions

4. The Royal Society. Long Covid: what is it, and what is needed? 2020 [updated 23 October 2020. Available from: https://royalsociety.org/-/media/policy/projects/set-c/set-c-long-covid.pdf

5. World Health Organization (WHO). Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID Copenhagen, Denmark: WHO,; 2021 [Available from: https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf.

6. NICE SaR. COVID-19 rapid guideline: managing the longterm effects of COVID-19. 2021 Contract No.: 16.5.22.

7. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, et al. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. Scientific Reports. 2021;11(1):16144.

8. Hayes LD, Ingram J, Sculthorpe NF. More Than 100 Persistent Symptoms of SARS-CoV-2 (Long COVID): A Scoping Review. Frontiers in Medicine. 2021;8.

9. Cau R, Faa G, Nardi V, Balestrieri A, Puig J, Suri JS, et al. Long-COVID diagnosis: From diagnostic to advanced AI-driven models. European Journal of Radiology. 2022;148:110164.

10. COVID Symptom Study. Long COVID: What do we know so far? 2021 [updated 12 April 2021. Available from: https://covid.joinzoe.com/post/long-covid-what-we-know.

11. Bull-Otterson L BS, Saydah S, et al. . Post–COVID Conditions Among Adult COVID-19 Survivors Aged 18–64 and ≥65 Years — United States, March 2020–November 2021. MMWR Morb Mortal Wkly Rep. 2022;71:723-17.

12. Nasserie T, Hittle M, Goodman SN. Assessment of the Frequency and Variety of Persistent Symptoms Among Patients With COVID-19: A Systematic Review. JAMA Network Open. 2021;4(5):e2111417-e.

13. Fernández-Castañeda A, Lu, P., et al. Mild respiratory COVID can cause multi-lineage neural cell and myelin dysregulation. Cell. 2022.

14. Multisystem involvement is common in post-COVID-19 syndrome. Nature Medicine. 2022;28(6):1139-40.

15. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. BMJ Global Health. 2021;6(9):e005427.

16. Groff D, Sun A, Ssentongo AE, Ba DM, Parsons N, Poudel GR, et al. Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review. JAMA Network Open. 2021;4(10):e2128568-e.

17. Antonelli MP, J.C, et al. Risk of long COVID associated with delta versus omicron variants of SARS-CoV-2. The Lancet. 2022;399(10343):2263-4.

18. Murdoch Children's Research Institute (MCRI). Research Brief: COVID-19 and Child and Adolescent Health Victoria, Australia: MCRI,; 2021 [updated 13 September 2021. Version 1:[Available from: https://www.mcri.edu.au/sites/default/files/media/documents/covid-19-and-child-and-adolescent-health-140921.pdf.

19. Zimmermann P, Pittet LF, Curtis N. How Common is Long COVID in Children and Adolescents? The Pediatric Infectious Disease Journal. 2021;40(12).

20. Radtke T, Ulyte A, Puhan MA, Kriemler S. Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents. JAMA. 2021;326(9):869-71.

21. Munblit D, Sigfrid L, Warner JO. Setting Priorities to Address Research Gaps in Long-term COVID-19 Outcomes in Children. JAMA Pediatrics. 2021;175(11):1095-6.

22. Molteni E, Sudre CH, Canas LS, Bhopal SS, Hughes RC, Antonelli M, et al. Illness duration and symptom profile in symptomatic UK school-aged children tested for SARS-CoV-2. The Lancet Child & Adolescent Health. 2021:708-18.

23. Sigfrid L, Drake TM, Pauley E, Jesudason EC, Olliaro P, Lim WS, et al. Long Covid in adults discharged from UK hospitals after Covid-19: A prospective, multicentre cohort study using the ISARIC WHO Clinical Characterisation Protocol 2021 [2021.03.18.21253888]. Available from: http://medrxiv.org/content/early/2021/03/23/2021.03.18.21253888.abstract.

24. Say D, Crawford N, McNab S, Wurzel D, Steer A, Tosif S. Post-acute COVID-19 outcomes in children with mild and asymptomatic disease. The Lancet Child & Adolescent Health. 2021;5(6):e22-e3.

25. Zimmermann P, Pittet LF, Curtis N. The Challenge of Studying Long COVID: An Updated Review. The Pediatric infectious disease journal. 2022;41(5):424-6.

26. Roessler M, Tesch F, Batram M, Jacob J, Loser F, Weidinger O, et al. Post COVID-19 in children, adolescents, and adults: results of a matched cohort study including more than 150,000 individuals with COVID-19 2021 [2021.10.21.21265133]. Available from: http://medrxiv.org/content/early/2021/10/22/2021.10.21.21265133.abstract.

27. Office for National Statistics UK. Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK 2021 [Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/alldatarelatingtoprevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk.

28. Lewis D. Long COVID and kids: scientists race to find answers: Nature; 2021 [updated 18 November 2021. Available from: https://www.nature.com/articles/d41586-021-01935-7?utm_source=twt_nat&utm_medium=social&utm_campaign=nature.

29. Buonsenso D, Munblit D, De Rose C, Sinatti D, Ricchiuto A, Carfi A, et al. Preliminary evidence on long COVID in children. Acta Paediatrica. 2021.

30. KiKKenborg Berg S, Palm, P. et al. Long COVID symptoms in SARS-CoV-2-positive children aged 0–14 years and matched controls in Denmark (LongCOVIDKidsDK): a national, cross-sectional study. The Lancet Child & Adolescent Health. 2022.

31. Stephenson T, Pinto Pereira SM, Shafran R, de Stavola BL, Rojas N, McOwat K, et al. Physical and mental health 3 months after SARS-CoV-2 infection (long COVID) among adolescents in England (CLoCk): a national matched cohort study. The Lancet Child & Adolescent Health. 2022.

32. Jason LA, Katz BZ, Shiraishi Y, Mears CJ, Im Y, Taylor R. Predictors of Post-Infectious Chronic Fatigue Syndrome in Adolescents. Health Psychol Behav Med. 2014;2(1):41-51.

33. Katz BZ, Shiraishi Y, Mears CJ, Binns HJ, Taylor R. Chronic fatigue syndrome after infectious mononucleosis in adolescents. Pediatrics. 2009;124(1):189-93.

34. Martin C, Luteijn M, Letton W, Robertson J, McDonald S. A model framework for projecting the prevalence and impact of Long-COVID in the UK. PloS one. 2021;16(12):e0260843-e.

35. Ministry of Health NZ. Long COVID 2021 [updated 21 June 2021. Available from: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.

36. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing Long COVID in an International Cohort: 7 Months of Symptoms and Their Impact 2021 [2020.12.24.20248802]. Available from: http://medrxiv.org/content/early/2021/04/05/2020.12.24.20248802.abstract.

37. Chen C, Haupert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review. The Journal of Infectious Diseases. 2022.

38. Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ. Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLOS Medicine. 2021;18(9):e1003773.

39. Zeng N, Zhao Y-M, Yan W, Li C, Lu Q-D, Liu L, et al. A systematic review and meta-analysis of long term physical and mental sequelae of COVID-19 pandemic: call for research priority and action. Molecular Psychiatry. 2022.

40. Wulf Hanson S, Abbafati C, Aerts JG, Al-Aly Z, Ashbaugh C, Ballouz T, et al. A global systematic analysis of the occurrence, severity, and recovery pattern of long COVID in 2020 and 2021. medRxiv. 2022:2022.05.26.22275532.

41. Frere JJ, Serafini RA, Pryce KD, Zazhytska M, Oishi K, Golynker I, et al. SARS-CoV-2 infection in hamsters and humans results in lasting and unique systemic perturbations post recovery. Science Translational Medicine.0(0):eabq3059.

42. Pustake M, Tambolkar I, Giri P, Gandhi C. SARS, MERS and CoVID-19: An overview and comparison of clinical, laboratory and radiological features. Journal of Family Medicine and Primary Care. 2022;11(1):10-7.

43. Newman M. Chronic fatigue syndrome and long covid: moving beyond the controversy. The BMJ. 2021.

44. Centers for Disease Control and Prevention (CDC). Post-COVID Conditions: Overview 2021 [updated 9 July 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Fclinical-care%2Flate-sequelae.html.

45. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Risk factors for long COVID: analyses of 10 longitudinal studies and electronic health records in the UK. medRxiv. 2021:2021.06.24.21259277.

46. Stewart S, Newson L, Briggs TA, Grammatopoulos D, Young L, Gill P. Long COVID risk - a signal to address sex hormones and women's health. The Lancet Regional Health – Europe. 2021;11.

47. Sylvester SV, Rusu R, Chan B, Bellows M, O'Keefe C, Nicholson S. Sex differences in sequelae from COVID-19 infection and in long COVID syndrome: a review. Current Medical Research and Opinion. 2022:1-9.

48. Al-Aly Z, Bowe B, Xie Y. Long COVID after breakthrough SARS-CoV-2 infection. Nature Medicine. 2022.

49. Cervia C, Zurbuchen Y, Taeschler P, Ballouz T, Menges D, Hasler S, et al. Immunoglobulin signature predicts risk of post-acute COVID-19 syndrome. Nat Commun. 2022;13(1):446.

50. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, et al. Attributes and predictors of long COVID. Nature Medicine. 2021;27(4):626-31.

51. Su Y, Yuan D, Chen DG, Ng RH, Wang K, Choi J, et al. Multiple early factors anticipate post-acute COVID-19 sequelae. Cell. 2022;185(5):881-95.e20.

52. Liu Q, Mak JWY, Su Q, Yeoh YK, Lui GC-Y, Ng SSS, et al. Gut microbiota dynamics in a prospective cohort of patients with post-acute COVID-19 syndrome. Gut. 2022;71(3):544.

53. Antonelli M, Penfold RS, Merino J, Sudre CH, Molteni E, Berry S, et al. Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study. The Lancet Infectious Diseases. 2022;22(1):43-55.

54. Gold JE, Okyay RA, Licht WE, Hurley DJ. Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation. Pathogens. 2021;10(6):763.

55. Ayoubkhani D, Bermingham C, Pouwels KB, Glickman M, Nafilyan V, Zaccardi F, et al. Trajectory of long covid symptoms after covid-19 vaccination: community based cohort study. BMJ. 2022;377:e069676.

56. Sivan M, Greenhalgh T, Milne R, Delaney B. Are vaccines a potential treatment for long covid? BMJ. 2022;377:o988.

57. UK Health Security Agency. The effectiveness of vaccination against long COVID. A rapid evidence briefing 2022 [Available from: https://ukhsa.koha-ptfs.co.uk/cgi-bin/koha/opac-retrieve-file.pl?id=fe4f10cd3cd509fe045ad4f72ae0dfff.

58. UKHSA review shows vaccinated less likely to have long COVID than unvaccinated [press release]. UK Government, 15 Feb 2022 2022.

59. Mahase E. Covid-19: Vaccinated people are less likely to get long covid, review finds. BMJ. 2022;376:o407.

60. Tsuchida T, Hirose M, Inoue Y, Kunishima H, Otsubo T, Matsuda T. Relationship between changes in symptoms and antibody titers after a single vaccination in patients with Long COVID. Journal of Medical Virology. 2022;94(7):3416-20.

61. Reardon S. Long COVID risk falls only slightly after vaccination, huge study shows: Nature News; 2022 [updated 25 May 2022. Available from: https://www.nature.com/articles/d41586-022-01453-0.

62. Simon MA, Luginbuhl RD, Parker R. Reduced Incidence of Long-COVID Symptoms Related to Administration of COVID-19 Vaccines Both Before COVID-19 Diagnosis and Up to 12 Weeks After. medRxiv. 2021:2021.11.17.21263608.

63. Arnold DT, Milne A, Samms E, Stadon L, Maskell NA, Hamilton FW. Are vaccines safe in patients with Long COVID? A prospective observational study 2021 [2021.03.11.21253225]. Available from: http://medrxiv.org/content/early/2021/03/14/2021.03.11.21253225.1.abstract.

64. Strain WD, Sherwood O, Banerjee A, Van der Togt V, Hishmeh L, Rossman J. The Impact of COVID Vaccination on Symptoms of Long COVID: An International Survey of People with Lived Experience of Long COVID. Vaccines. 2022;10(5):652.

65. Faghy MA, Maden-Wilkinson T, Arena R, Copeland RJ, Owen R, Hodgkins H, et al. COVID-19 patients require multi-disciplinary rehabilitation approaches to address persisting symptom profiles and restore pre-COVID quality of life. Expert Review of Respiratory Medicine. 2022:1-6.

66. Hussain FA. Facilitating care: a biopsychosocial perspective on long COVID. British Journal of General Practice. 2022;72(714):30-1.

67. Maltezou HC, Pavli A, Tsakris A. Post-COVID Syndrome: An Insight on Its Pathogenesis. Vaccines (Basel). 2021;9(5).

68. RACGP. Caring for adult patients with post-COVID-19 conditions East Melbourne, VIC2020 [

69. The National Institute for Health Innovation. Long COVID 2021 [Available from: https://www.nihi.auckland.ac.nz/long-covid.

70. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, et al. Post-acute COVID-19 syndrome. Nature Medicine. 2021;27(4):601-15.

71. Greenhalgh T, Knight M, A'Court C, Buxton M, Husain L. Management of post-acute covid-19 in primary care. BMJ. 2020;370:m3026.

72. Hawkins J, Hires C, Keenan L, Dunne E. Aromatherapy blend of thyme, orange, clove bud, and frankincense boosts energy levels in post-COVID-19 female patients: A randomized, double-blinded, placebo controlled clinical trial. Complementary Therapies in Medicine. 2022;67:102823.

73. Jeon S-R, Kang JW, Ang L, Lee HW, Lee MS, Kim T-H. Complementary and alternative medicine (CAM) interventions for COVID-19: An overview of systematic reviews. Integrative Medicine Research. 2022;11(3):100842.

74. Nelson V LM, Richard L, et al. Examining the barriers and facilitators for Māori accessing injury and rehabilitation services: a scoping review protocol. BMJ open. 2022;12.

75. de Leeuw E, Yashadhana A, Hitch D. Long COVID: sustained and multiplied disadvantage. Medical Journal of Australia. 2022;216(5):222-4.

76. Dahlgren G, Whitehead M. The Dahlgren-Whitehead model of health determinants: 30 years on and still chasing rainbows. Public Health. 2021;199:20-4.

77. Diderichsen F, Hallqvist J, Whitehead M. Differential vulnerability and susceptibility: how to make use of recent development in our understanding of mediation and interaction to tackle health inequalities. International Journal of Epidemiology. 2019;48(1):268-74.

78. Walter K. An Inside Look at a Post–COVID-19 Clinic. JAMA. 2021.

79. Skirrow P, Morris, L. Thoughts that Count [Presentation]. 2022 [Available from: https://az659834.vo.msecnd.net/eventsairaueprod/production-otago-public/bfb8d575b3b342c7b72be4c5fb221c0c.

80. Scottish Intercollegiate Guidelines Network. SIGN 161: Managing the long-term effects of COVID-19: National guidance for identification, assessment and management Edinburgh: SIGN; 2020 [updated 18 December 2020. Available from: https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf.

[i] British Medical Journal – COVID-19 How Europe is approaching long COVID - https://www.bmj.com/content/376/bmj.o158 - Accessed 13 May 2022

[ii] UK Government - Find help and support if you have long COVID - https://www.gov.uk/guidance/find-help-and-support-if-you-have-long-covid#if-you-have-long-covid-and-are-unable-to-work – Accessed 13 May 2022

Document 7

SCIENCE & TECHNICAL ADVISORY | RŌPŪ TOHUTOHU I TE PŪTAIAO ME TE HANGARAU

Request for Advice (RfA)

MINISTRY OF HEALTH | MANATŪ HAUORA

This form contains the details relevant to the questions posed to the Science and Technical Advisory (STA). STA will respond to the request using this form which will also be stored in STA content management system for future reference.

This form, or parts of it, may also be forwarded to other relevant parties as appropriate.

Title	Long COVID Evidence Update		
Subject	Underlying science and long-term health impacts of COVID-19		
Reference No.	526	Date Received	1/07/2022
Requestor	Martin Chadwick, Chief Allied Health Professions Officer from the Ministry of Health.	Date Due	11/08/2022
Advisor	Eloise Williams, Senior Advisor Sarah Mitchell, Senior Advisor Fiona Stephens, Senior Advisor Brittany Illingworth, Advisor	Date Completed	11/08/2022
Peer reviewed by	Mark Ayson, Principal Advisor Brooke Hollingshead, Team Leader		
Advice issued to	Martin Chadwick, Chief Allied Health Professions Officer		
Approved by	Dan Bernal, Manager, Science & Technical Advisory		
Deliverables	A review of the evidence and health impacts on long-term effects of COVID-19		

Request Outline

Background/Context

In developing a work programme for long COVID, CAHPO have requested a regular update on what is known about the science and evidence on long COVID, and awareness of what other countries are establishing to support people with this condition.

Questions

Long COVID terminology and definitions	· What are the various terms used to describe ongoing health effects following the acute COVID-19 illness? · What are the clinical case definitions used by various organisations/ countries?

Diagnosis	· What are the limitations or challenges in making a diagnosis of long COVID? · Are there any tests available to assist with diagnosing the condition? (e.g., immune function tests)
Symptoms and signs	· Outline the range of symptoms and signs that have been associated with long COVID · Which symptoms are most common? · Disease course - pattern and severity of symptoms · Is there any association between particular variants and the types of long COVID symptoms?
Psychosocial impacts	· What kinds of mental health impacts are long COVID patients experiencing? · What impact can long COVID have on ability to work? · How does long COVID impact on quality of life overall?
Prevalence/ incidence	· What is the estimated prevalence of long COVID in various groups, including by: age (including children), ethnicity (including Indigenous), remote/rural geography, social and economic status, gender, severity of initial infection, hospitalised vs non-hospitalised, and at various timeframes after the acute illness?
	· What is the estimated prevalence of long COVID in key countries, according to sources in country? Which demographics have been most impacted by long COVID (e.g., in terms of gender, age, and ethnicity)? Key countries could include Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain.
Aetiology	· What are the proposed mechanisms which contribute to the development of long COVID?
Risk factors	· What are the risk factors for developing long COVID?
Treatment and support	· Are there established treatments and supports known to help patients with long COVID? · What are the other treatments being investigated for long COVID patients? · What models of care are other countries putting in place/ exploring? · What guidelines do other countries/ organisations have in place for rehabilitation of patients with long COVID?
Prevention (see also, vaccination)	· Aside from vaccination, are there any other ways to reduce the risk of developing long COVID once infected with SARS-CoV-2? (e.g., importance of rest during acute illness)

Vaccination	· Does vaccination before infection reduce the symptoms or incidence of long COVID? · Does previous vaccination affect severity of symptoms in people with long COVID? · Is it considered safe for patients with long COVID to receive COVID-19 vaccines? · Does vaccination of patients with existing long COVID affect their symptoms/ disease course?
Social and economic impact	· What are the current and projected economic impacts of long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain, according to sources in country? *(Including workforce impacts such as sick days/absences, financial costs to employers, impacts on sectors).*
Policy responses	· How have governments responded to long COVID in Australia, the United States, the United Kingdom, Singapore, Taiwan, Hong Kong, Canada, Ireland, Northern Ireland, Scotland, Sweden, and Spain, according to sources in country? · Has the government classed long COVID as a disability? · What social support schemes are available for people with long COVID? · What are government recommendations to employers around how to manage employees with long COVID? · What are the current treatment pathways available for those facing long COVID and what barriers are people facing in accessing these pathways?

Intended application of advice

To inform development of support packages and rehabilitation pathways for people with long COVID.

Timeline

First evidence brief was sent on Friday 20 May 2022. The second evidence brief was shared on 1 July 2022, and the authors spoke to this at the Long COVID Expert Advisory Group and received feedback and guidance on future lines of enquiry. This next update will be provided to the CAHPO and EAG for the 17 August meeting.

What are the implications and considerations of this advice on Te Tiriti o Waitangi and equity?

COVID-19 has disproportionately affected vulnerable populations and exacerbated existing inequities, and the burden of long COVID is likely to continue this trend. In New Zealand, Māori and Pacific peoples make up an increasing proportion of COVID-19 cases, so long COVID may have a particularly high burden in these populations. They may also face additional barriers seeking or accessing treatment for long COVID or financial barriers to affording treatment due to existing healthcare access issues being exacerbated by difficulties in diagnosis and accessing care pathways.

For some people, long COVID results in being unable to work for an extended period. Support options for these situations need to be considered. In addition, long COVID is a complex condition that may not be adequately understood or recognised by the medical profession, creating further difficulties for patients seeking validation of their experience and support, worsening existing access and equity issues.

Throughout this report, we will consider equity considerations, and specifically explore questions related to: What equity issues are evident in long COVID experiences and responses overseas? Are there any useful examples from overseas of how to ensure long COVID is addressed equitably? How might New Zealand experience inequities with respect to long COVID and how could these be mitigated?

Long COVID Evidence Update

Key Points

- No international definition has been agreed upon for ongoing symptoms following acute SARS-CoV-2 infection, and the time period of ongoing symptoms varies from 4 weeks to 12 weeks and onwards.
- The New Zealand Ministry of Health has received recommendations from the Long COVID Expert Advisory Group and agreed to adopt a consistent clinical case definition for long COVID to use in Aotearoa New Zealand. The joint guideline by the National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and the Royal College of General Practitioners (RCGP) will be adopted to distinguish between ongoing COVID and long COVID cases. This definition differentiates acute COVID-19 (signs and symptoms up to 4 weeks) from ongoing symptomatic COVID-19 (4 weeks to 12 weeks) from Post-COVID-19 syndrome (from 12 weeks.
- A definition of long COVID in children and young people has been developed using the Delphi method: "*Post-COVID-19 condition occurs in young people with a history of confirmed SARS-CoV-2 infection, with at least one persisting physical symptom for a minimum duration of 12 weeks after initial testing that cannot be explained by an alternative diagnosis. The symptoms have an impact on everyday functioning, may continue or develop after COVID infection, and may fluctuate or relapse over time*".
- There are a range of signs and symptoms that have been associated with long COVID. Symptoms can be respiratory, cardiopulmonary, neurological, or systemic. They can be concurrent, fluctuating and overlapping. Symptoms vary in severity and site over time, including symptom-free periods followed by relapses. The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, and respiratory symptoms.
- Long COVID in children is not well described, and prevalence estimates vary widely. There is some emerging evidence that signs and symptoms or clinical presentation may differ for children, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults. A study published on 22 July found 9.8% of hospitalised children and 4.8% of discharged children infected with SARS-CoV-2 and tested in emergency departments went on to report post–COVID-19 conditions (PCCs) 90 days later. The report also indicated that persistent, new or reoccurring health problems were reported in 60% of children who had reported PCCs at 90 days. The most common reported symptoms were respiratory (eg, cough, difficulty breathing, or shortness of breath) and systemic (general fatigue and fever). Risk factors for reporting PCCs included the number of acute symptoms, length of hospitalization, and older age of child.
- The prevalence of long COVID is difficult to establish for a range of reasons, however preliminary studies suggest that approximately 30% of people who test positive for COVID-19 experience symptoms for 12 weeks or longer. (1)
- Evidence continues to emerge on the cause/s of long COVID. A range of factors have been suggested to contribute including effects of the virus on the body (particularly on the nervous and vascular systems) or persistent virus or virus fragments lingering and causing inflammation; autoimmunity triggered by SARS-CoV-2 infection; changes in the microbiome and viral reactivation; or unrepaired tissue damage from original infection.
- Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness, but it can also affect those who initially had mild or moderate COVID-19. Some factors that have been associated with an increased risk of long COVID include increased age, poor pre-pandemic general and mental health, asthma, having underlying health conditions, a higher body

mass index, and being female. Vaccines are important in preventing long COVID and are effective prior to infection and post-infection.

- In Aotearoa New Zealand, Māori may have an increased risk of developing long COVID given the higher rates of COVID-19 in this group, and lower vaccination rates. The potential inequitable impact of long COVID on Māori is concerning and is receiving recent media attention (link).
- One case-control study from the UK has found that the risk of ongoing symptoms or long COVID after Omicron infection is approximately half of the risk after Delta infection. Although the percentage of Omicron infections leading to long COVID were lower, the absolute numbers are still expected to be greater than for Delta due to the increased numbers that were infected by Omicron, and therefore the impact on the health system could still be significant. Evidence is still emerging on the potential impact of BA.4 and BA.5 (the latest and now dominant sublineages of Omicron) for long COVID. Initial literature suggests these variants are capable of increased immune evasion due to mutations in the surface spike proteins and increases in transmissibility and infection are likely to increase prevalence of long COVID. There is no published evidence, grey literature or media reports suggesting a decline in demand for services with Omicron, however the number of people self-reporting persistent symptoms beyond four weeks in the UK reduced from approximate 2million to 1.8million between May and July, which may have impacted demand. However, the number reporting persistent symptoms beyond 12 weeks remained stable at 1.4million (link).
- The effect of vaccination on pre-existing long COVID remains uncertain and contentious, though most studies comparing long COVID symptoms before and after vaccination reported an improvement in symptoms after vaccination, either immediately or over several weeks. Analysis evaluating differences between COVID-19 vaccine types and long COVID outcomes found minor difference between vaccines on preventing long COVID, however those who received Moderna were more likely to report fatigue, myalgia and chest pain than those who received AstraZeneca.
- There has been some discourse suggesting vaccine injury may lead to long COVID symptoms. Some small-scale research has been undertaken however it was inconclusive in its findings, and no causative link was found.
- Long COVID patients are reporting multiple psychosocial impacts, including mental health related impacts, affecting the ability of some patients to work.
- While the fiscal impacts of the COVID-19 pandemic, in general, is well known and reported on across jurisdictions, the fiscal impacts of long-term health impacts and long COVID are less well known but could include decreased productivity from a reduction of participants in the workforce, to costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.
- Preliminary analysis from Ngā Kawekawe o Mate Korona has found that 45% of Māori with long COVID say their usual activities have been affected to a moderate or extreme level; about 20% have severe pain and about 10% have difficulty moving.
- There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definition.
- As long COVID has emerged, many healthcare professionals and researchers have compared the experience to other post-viral conditions such as myalgic encephalomyelitis/ chronic fatigue syndrome (ME/CFS) due to the similarities in symptoms and affected demographic, and therefore many researchers are postulating that long COVID may be a sub-type of ME/CSF.
- Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options vary for people with long COVID. There is an emerging consensus on best practice which

points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient, and development of an individualised management plan.

- There are an increasing number of international guidelines available for clinical management of patients with long COVID which are briefly presented here. Currently, there are no collated Aotearoa New Zealand resources for symptom management.
- Te Whatu Ora – Waitemātā have developed Aotearoa New Zealand contextualised patient resources which includes guidance on what long COVID is. It shares tips and tricks for managing long COVID and looking after yourself, ensuring people with long COVID tend to not only their physical health but all aspects of Te Whare Tapa Whā, including advice for self-care, eating well, relaxation. Specific guidance on coping with brain fog or cognitive changes is included, as well as guidance on managing fatigue and pacing, headaches, and keeping track of symptoms.
- A new section on service evaluation has been added.

Introduction

In the early stages of the pandemic, most attention was focused on the acute health impacts of SARS-CoV-2 infection. (2) It was initially thought that although some people have a prolonged and complicated hospital stay, most people recover from 'mild' infections within two weeks and from more serious disease within three weeks. (3) However, it has become clear that for some people COVID-19 can lead to persistent illness, with ongoing and often debilitating symptoms. (3-5)

This document is a summary of the current evidence known about the long-term health impacts of COVID-19, often referred to as long COVID, and the experiences of people living with long-term complications of COVID-19. It is a collation of expert opinion and the latest scientific and technical research exploring the ongoing nature or long-term presentation of signs and symptoms that appear or continue to occur after the acute phase of COVID-19, as well as aetiology, epidemiology, issues related to the impact of vaccination and new emerging variants. Developments in international guidance from peak bodies on diagnosis, management, support, and rehabilitation pathways will also be explored. It reflects current knowledge at the time of writing (August 2022). It is a live and working document which will be updated as new evidence emerges, with an updated report scheduled to be shared every eight to twelve weeks with the Chief Allied Health Professions Office (CAHPO), Ministry of Health, Aotearoa New Zealand. New evidence in this update will be in red.

Long COVID terminology and definitions

Ongoing symptoms are common following many viral and bacterial infections, including other coronaviruses. The term 'long COVID' is commonly used to describe signs and symptoms that continue or develop after acute COVID-19 (up to four weeks from the initial infection); however, some definitions consider long COVID to be ongoing symptoms from 12 weeks onwards. Symptoms may last for weeks or months after the acute illness. The presence of lingering symptoms may have a significant impact on the daily lives of those who are affected, their family and whānau. Given the numbers of people who have been or will be infected with SARS-CoV-2 worldwide, the public health impact of long COVID could be significant.

Across the international literature, long COVID may be referred to by many names, including post-COVID-19 syndrome, long-haul COVID, post-acute COVID-19, post-acute sequelae of SARS CoV-2 infection, long-term effects of COVID, and chronic COVID.

There is no internationally agreed definition of the long COVID condition yet.

Aotearoa New Zealand will have a unique long COVID profile due to the early successes in transmission reduction in the pandemic. The low prevalence of COVID-19 in Aotearoa New Zealand prior to Omicron has resulted in a proportionally low incidence of long COVID prior to 2022. However, with the arrival of Omicron and its sublineages and Aotearoa New Zealand now having had nearly 1.7 million confirmed cases of COVID-19, an increase in long COVID cases is expected to be seen.

It has been identified that it is clinically important to establish a clear and standardised definition for long COVID in Aotearoa New Zealand. This will lead to more consistent data collection, analysis, and reporting which is essential for an accurate estimate of the prevalence of long COVID in the population and to allow a better understanding of the impacts of long COVID in Aotearoa New Zealand.

The Ministry of Health has received recommendations from the Long COVID Expert Advisory Group and agreed to adopt a consistent clinical case definition for long COVID to use in Aotearoa. This includes the following recommendations that:

- the definition is specific and provides exact timeframes that differentiate between ongoing systematic COVID-19 and long COVID; and,
- allows for inclusion in the diagnosis irrespective of COVID-19 test result, allows treatment for people who may have had a false negative result, were unable to access testing, and/or have a test conducted.

It has been agreed to adopt the clinical case definitions from the joint guideline used by the National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and the Royal College of General Practitioners (RCGP) to distinguish between ongoing COVID and long COVID cases.

This definition is as follows:

- Acute COVID 19: Signs and symptoms for up to 4 weeks
- Ongoing symptomatic COVID-19: Signs and symptoms of COVID-19 from 4 weeks up to 12 weeks.
- Post-COVID-19 syndrome:
    - signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks and are not explained by an alternative diagnosis. It usually presents with clusters of symptoms, often overlapping, which can fluctuate and change over time and can affect any system in the body
    - post-COVID-19 Syndrome may be considered before 12 weeks while the possibility of an alternative underlying disease is also being assessed
    - in addition to the clinical case definitions, the term ‘long COVID’ is commonly used to describe the signs and symptoms that continue or develop after acute COVID-19. It includes both ongoing symptomatic COVID-10 (from 4 to 12 weeks) and post-COVID-19 syndrome (12 weeks or more).(6)

Other widely used international definitions include those from the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC), as defined below.

The WHO published the following clinical case definition (created by Delphi consensus) in October 2021:

> "Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis.
>
> Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others which generally have an impact on everyday functioning.
>
> Symptoms may be new onset, following initial recovery from an acute COVID-19 episode, or persist from the initial illness. Symptoms may also fluctuate or relapse over time. A separate definition may be applicable for children."

The CDC in the US uses the term 'post-COVID conditions' to describe long COVID, defined as a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19.

A study published online on 17 June 2022 aimed to develop a long COVID definition in children and young people (CYP) using the Delphi method. (7) After three rounds of surveys and a consensus meeting, ten statements were collected, with five meeting the threshold for inclusion into the research definition. The resulting definition was outlined as "*Post-COVID-19 condition occurs in young people with a history of confirmed SARS-CoV-2 infection, with at least one persisting physical symptom for a minimum duration of 12 weeks after initial testing that cannot be explained by an alternative diagnosis. The symptoms have an impact on everyday functioning, may continue or develop after COVID infection, and may fluctuate or relapse over time*". This definition aimed to align itself with the WHO clinical case definition for adults. The positive COVID-19 test result referred by this definition can be either an PCR test, lateral flow antigen test ('rapid antigen test') or antibody test.

Symptoms and Signs

There are **a range of signs and symptoms** that have been associated with long COVID. Signs and symptoms can vary greatly, and one systematic review and meta-analysis completed in early 2021 found 55 long-term effects noted across 15 studies. (8) Another review conducted in November 2021 looked at 50 studies and found more than 100 persistent symptoms reported. (9) Symptoms can be respiratory, cardiopulmonary, neurological, or generalised, as it detailed in Table 1 below. (10)

Table 1: Commonly reported symptoms of long COVID

Cardiopulmonary ☐ Difficulty breathing or shortness of breath ☐ Cough ☐ Chest pain, tightness, or heaviness [1] ☐ Palpitations **Neurological** ☐ Cognitive impairment ('brain fog', loss of concentration or memory issues) ☐ Headache	**Generalised symptoms** ☐ Fatigue ☐ Fever ☐ Pain ☐ Reduced exercise capacity **Gastrointestinal** ☐ Abdominal pain ☐ Nausea ☐ Diarrhoea

[1] Clinical assessment is required to investigate the specific cause

☐ Sleep disturbance ☐ Peripheral neuropathy symptoms (pins and needles, numbness) ☐ Ongoing changes to smell or taste ☐ Dizziness ☐ Delirium (in older populations) **Musculoskeletal** ☐ Muscle aches and pains ☐ Muscle weakness[2] ☐ Joint pain **Psychological/ psychiatric symptoms**[3] ☐ Symptoms of depression ☐ Symptoms of anxiety	☐ Anorexia and reduced appetite (in older populations) **Ear, nose, and throat** ☐ Tinnitus ☐ Earache ☐ Sore throat ☐ Dizziness **Other** ☐ Skin rashes (including vesicular, maculopapular, urticarial, or chilblain-like lesions on the extremities) ☐ Metallic or bitter taste ☐ Metabolic disruption (such as poor control of diabetes) ☐ Thromboembolic conditions

Some research indicates that people experiencing long COVID tend to fall into one of two symptom groups: those experiencing ongoing respiratory symptoms (including coughing and shortness of breath) combined with fatigue and headaches; and those experiencing multi-systemic symptoms, affecting the heart, brain and gut (for example, palpitations and 'brain fog'). (11) A report from the CDC (May, 2022) suggests that people who have had COVID-19 have twice the risk of respiratory conditions or developing pulmonary embolism than those who have not had COVID-19. Furthermore, respiratory conditions had the highest risk ratios reported of conditions associated with long COVID. (12)

In addition to the wide range of possible symptoms, some of the key features of long COVID include:

- ☐ Concurrence of multisystem, fluctuating and often overlapping 'clusters' of symptoms
- ☐ Symptoms that vary in severity and site over time, including symptom-free periods followed by relapses
- ☐ Symptom severity may range from mild to incapacitating
- ☐ Worsening of symptoms after physical or mental activity
- ☐ Relapses may occur in an irregular pattern or in response to specific triggers (e.g., physical, or mental activity, stress, menstruation, heat, or alcohol)
- ☐ People may experience new symptoms that were not present during the acute phase of their COVID-19 infection. (1, 3, 5)

The most reported symptoms of long COVID are fatigue or general malaise, headaches, cognitive impairment or attention disorders, or respiratory symptoms. One meta-analysis concluded that the effects largely corresponded with clinical symptoms including fatigue (58%), headache (44%), attention disorder or cognitive impairment/brain fogginess (27%), hair loss (25%) and dyspnea (24%) (shortness of breath). (8)

[2] Muscle weakness can be a reported symptom, and may also be clinically measured
[3] The WHO has noted that the association between long COVID and psychiatric disorders is likely bidirectional

Neurological symptoms, including persistent cognitive impairment, appear to be affecting as many as one-in-four people recovered from COVID-19. (13) COVID-associated cognitive impairment often includes impaired function relating to concentration, processing information speed, attention, and memory. (13) In an investigation of the mechanisms leading to this, a study led by the Stanford University School of Medicine found that even mild cases of COVID-19 could lead to prominent neuroinflammation (or more specifically, brain inflammation). This causes physical damage to the white matter in the brain that resembles damage seen after cancer chemotherapy, including disruption to the same cell types and processes. (14) This damage appears to contribute to the lingering neurological symptom (often termed 'brain-fog') reported by many with long COVID or undergoing chemotherapy. One positive from this association is that cancer therapy related treatments could provide insight into appropriate treatments for long COVID-induced neurological symptoms. (14)

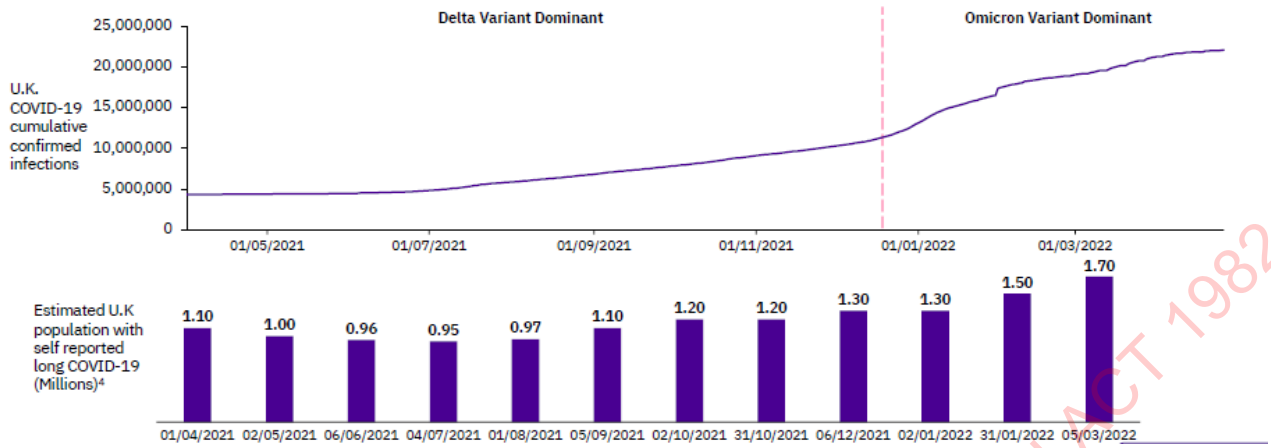
Another study found COVID-19 infections lead to persistent cardio-renal inflammation and activation of the haemostatic pathways which have implications to lung function. The impacts on multisystem injury pathways during SARS-CoV-2 infection could be considered to inform clinical guidelines in preventative measures for long COVID and support measures targeting preventative therapies. (15)

A systematic review and meta-analysis published in mid-April 2022 found over 60 physical and psychological signs and symptoms with wide variation in prevalence estimates reported across 39 studies, although, notably, most studies had a high or moderate risk of bias. The most reported symptoms were weakness (41%; 95% CI 25% to 59%), general malaise (33%; 95% CI 15% to 57%), fatigue (31%; 95% CI 24% to 39%), concentration impairment (26%; 95% CI 21% to 32%) and breathlessness (25%; 95% CI 18% to 34%). Thirty-seven percent (95% CI 18% to 60%) of patients reported reduced quality of life and 26% (10/39) of the studies presented evidence of reduced pulmonary function.(16) In May 2022 the CDC reported that in people with previous COVID-19 diagnosis, one in five individuals between 18-64 years reported at least one incidence of 26 conditions attributed to long COVID. This was even more common in people over 65 years, with one in four. (12)

There is limited evidence on any association between how symptom presentation of long COVID may differ between variants of SARS-CoV-2, and this could be confounded by a variety of factors such as the vaccination rollout, changes in treatment, as well as changes in detection and testing capacities and levels of community prevalence. With the high rates of community transmission of Omicron, and increased asymptomatic transmission, there is less detection of Omicron occurring, compounded by the shift to relying on rapid antigen tests. One early observational study found the Alpha variant was more likely to cause persistent cognitive symptoms when compared to the original Wuhan variant, though these could have been influenced by a range of causes. In this same study the Alpha variant appeared less likely to cause impaired hearing or a loss of sense of smell compared with the original variant. (17)

Omicron

There is limited data available on Omicron, however initial evidence from the UK's Office for National Statistics (ONS) suggests that despite lower case severity with Omicron, these variants are still presenting a significant long COVID burden, which appears to be largely driven by the higher number of cases. (link, visualisation by Airfinity)



The UK's ONS conducted a study using self-reported data from COVID-19 cases to explore the impact of Omicron BA.1 or BA.2 variants on long COVID. The data suggested that:

a) For vaccine boosted adults, there was not statistically significant difference in the risk of self-reported long COVID between first infections with the Delta variant and with either Omicron BA.1 or Omicron BA.2.
b) For boosted adults, the odds of reporting long COVID symptoms four to eight weeks after infection were 21.8% higher after Omicron BA.2 than Omicron BA.1.
c) For those with only a vaccine primary course of two doses, the survey found that the odds of reporting long COVID symptoms after infection were 49.7% lower in Omicron B.A1 infections than the Delta variant.

A June 2022 study has found that the risk of ongoing symptoms or long COVID after Omicron infection is approximately half of the risk after Delta infection. (18) In this UK based case-control study, the odds of symptoms 4 weeks or more post-infection (as per NICE definition) were compared in patients with Omicron (n=56,003 people, 55% female, mean age 53 years) and Delta (n=41,361, 59% female, mean age 53 years). In the Delta-infected cohort, 10.8% experienced ongoing symptoms compared to 4.5% in the Omicron cohort. Although the percentage of Omicron infections leading to long COVID were lower, the absolute numbers are still expected to be greater than for Delta due to the increased numbers that were infected by Omicron, and therefore the impact on the health system could still be significant. The study was unable to estimate the incidence of ongoing symptoms or long COVID in children nor did it compare vaccination statuses. (18)

BA.4 and BA.5 are two of the latest variant sub-lineages of the Omicron strain. These variants are currently the most prevalent within the New Zealand community as of August 2022. The implications towards long COVID incidence as a result from infection with these new sub-variants is currently unknown. The literature suggests that these variants are capable of increased immune evasion due to mutations in the surface spike proteins. (19) Internationally it is estimated that second and third waves of infection due to new sub-variants are likely to increase prevalence of long COVID, (20)particularly amongst those in high exposure environments e.g. healthcare workers. (20)

There is no published evidence, grey literature or media reports suggesting a decline in demand for services with Omicron, however the number of people self-reporting persistent symptoms beyond four weeks in the UK reduced from approximate 2million to 1.8million between May and July, which may have impacted

demand. However, the number reporting persistent symptoms beyond 12 weeks remained stable at 1.4million (link).

Long COVID in children

Long COVID in children is not well described, and the studies to date have generally been of poor quality, with some significant limitations (such as a lack of a clear case definition, arbitrary follow up time points, subjective assessment, lack of control groups, and low response rates). (21, 22) Evidence is predominantly limited to select populations without control groups. (23) Relatively few studies have focused on SARS-CoV-2 infection sequelae in children and adolescents, and large, harmonised longitudinal studies are needed. (24) Persistent illness in children has been noted in some studies and in patient support groups, but its prevalence, characteristics and duration are unclear. (25, 26) As is described above, a definition of long COVID for children and young people has been developed using the Delphi method.

Estimates of the prevalence of long COVID in children vary widely. (22) The variability in prevalence estimates could be due to a range of factors, such as initial SARS-CoV-2 infection severity, different methodological approaches (clinical assessment vs self-report), definition of cases (diagnosed vs suspected), variable follow-up times, and prevalence of pre-existing clinical conditions. (23) In the US, a large long-term study of the impacts of COVID-19 on children has recently begun. It will track up to 1,000 children and young adults and evaluate the impacts on their physical and mental health over three years. (24)

Some studies suggest that long COVID in children is less common and tends to be less protracted than in adults. (27) Other experts argue that accurately establishing how many children and adolescents experience long COVID is difficult and likely underestimated. This may be because acute SARS-CoV-2 infection is less severe in children, often making an initial diagnosis less likely. One report suggests that over half the children and adolescents reported psychological and physical symptoms related to long COVID, irrespective of whether they received a positive SARS-CoV-2 diagnosis or not, though this is difficult to interpret and highlights the impact of the pandemic on children and adolescents. (28)

There is some emerging evidence that signs and symptoms or clinical presentation may differ for children, with NICE in the UK noting cardiac and respiratory symptoms were less common in children than adults. The NICE panel noted that common presentation in children is a lack of concentration, short-term memory loss, and/or difficult doing everyday tasks ≥4 weeks after acute COVID-19 illness.

Some of the studies of long COVID in children include:

- A review of studies of long COVID in children and adolescents identified 14 heterogeneous studies (4 cross-sectional, 10 prospective cohort) investigating long COVID symptoms in a total of 19,426 children and adolescents. The prevalence of long COVID symptoms varied from 4% to 66%, and there was also large variation in the reported frequency of different symptoms. Zimmerman et al (2021) note that all the studies in their review were likely to have been conducted before the Delta variant became dominant, which may have a different risk of long COVID.(22)
- A pre-print from a German study of 157,134 individuals (11,950 children/adolescents and 145,184 adults) with confirmed COVID-19.(29) The COVID-19 and control cohorts were well-balanced regarding covariates. For all adverse health outcomes combined, incidence rates (IRs) in the COVID-19 cohort were significantly higher than those in the control cohort in both children/adolescents. Incidence rate ratio (IRR) estimates were similar for the age groups 0-11 and 12-17. Incidence rates

in children/adolescents were consistently lower than those in adults. Among the specific outcomes with the highest IRR and an incidence rate of at least 1/100 person-years in the COVID-19 cohort in children and adolescents were malaise/fatigue/exhaustion, cough, and throat/chest pain.

- The UK Office of National Statistics found that 9.8% of children aged 2-11 years and 13% aged 12-16 years reported at least one ongoing symptom five weeks after a positive diagnosis, whereas 25% of adults aged 35-69-years had symptoms five weeks after a positive diagnosis. (30, 31)
- A paper describing data from the UK COVID Symptom Study (a citizen science project with data collected via an app, which has some associated limitations) found that of 1,734 children aged 5-17 years who were symptomatic at the time of their positive test and reported symptoms regularly for at least 28 days, 4.4% had an illness duration of at least 28 days.(25) Ongoing symptoms for at least 28 days was less common in younger children aged 5-11 years (3.1%, p=0.046). Over 98% of 1,379 children had recovered by 56 days.(25) However, there may be some bias as using apps is likely to select participants from higher socio-economic background, who have a lower risk of poor outcomes. (22)
- One of the earliest studies on long COVID in children (a cross-sectional study of 129 children in Italy who were diagnosed with COVID-19 between March and November 2020) reported that 42.6% of children surveyed had one or more symptoms >60 days post infection.(32) This included children with mild or asymptomatic initial infection.
- A cohort study of 136 children (most of whom had mild or asymptomatic COVID-19) in Melbourne in 2020 observed that 8% of children had post-acute symptoms. They found that full recovery occurred within weeks of acute symptom onset and reported symptoms were mild in severity but noted this was a young cohort (median age three years).(27)
- A national, cross sectional study in Denmark has investigated the prevalence of ongoing symptoms of long COVID symptoms in children (0-14 years). It found that compared with controls, older children experiencing long COVID had lower quality-of-life scores relating to social and emotional functioning. (33) However, this study also has found that long-lasting symptoms associated with COVID-19 occurred frequently in children, regardless of whether they had a SARS-CoV-2 infection or not. This is an import observation as it outlines that symptoms in children come and go frequently and although they can persist for months they may not have an obvious cause. (33)
- A national cohort study using data from the Public Health England database looked at adolescents aged 11 to 17 years who tested positive between January and March 2021, who were then matched by month of test, age, sex, and geographical region to adolescents who tested negative. Three months after testing, 2038 (66.5%) who tested positive and 1993 (53.3%) who tested negative had any symptoms, and 928 (30.3%) from the test-positive group and 603 (16.2%) from the test-negative group had three or more symptoms. At 3 months after testing, the most common symptoms among the test-positive group were tiredness (1196 [39.0%]), headache (710 [23.2%]), and shortness of breath (717 [23.4%]), and among the test-negative group were tiredness (911 [24.4%]), headache (530 [14.2%]), and other (unspecified; 590 [15.8%]). Overall the study concluded that adolescents who tested positive for SARS-CoV-2 had similar symptoms to those who tested negative, but had a higher prevalence of single and, particularly, multiple symptoms at the time of PCR testing and 3 months later.(34)
- A further study in the US described a paediatric multidisicplinary post COVID-19 rehabilitation clinic model as well as a case series of patient presentations. The most common symptoms among

patients <21 years of age who presented to the clinic were fatigue, headaches, difficulty with schoolwork, brain fog and dizziness/lightheadedness. (35)

Long-term SARS-CoV-2 infection–associated symptoms can be difficult to distinguish from pandemic-associated symptoms. (21, 22) Some studies have found that children who tested negative for COVID-19 have had similar symptoms, which are common after other viral infections, and could also be due to the experience of lockdown and other social restrictions.(36, 37) Given that acute COVID-19 generally poses a low risk to children, an accurate determination of the risk of long COVID is important in the debate about the risks and benefits of vaccination in this age group.(22) Similar to adults, it is likely that long COVID in children may have a greater impact on those from socioeconomically disadvantaged areas and ethnic minority groups.(24)

In summary, "the relative scarcity of studies of long COVID and the limitations of those reported to date mean the true incidence of this syndrome in children and adolescents remains uncertain. The impact of age, disease severity and duration, virus strain, and other factors on the risk of long COVID in this age group also remains to be determined."(22) However, even if the proportion of children experiencing post-acute impacts is relatively low, if transmission is widespread (as has been with Omicron), then the impact of persisting symptoms will be considerable.

A study published on 22 July (38) assessed the proportion of children infected with SARS-CoV-2 tested in emergency departments, that then reported post–COVID-19 conditions (PCCs) 90 days later. (38) The results found that 9.8% of hospitalised children and 4.6% of discharged children reported PCCs. The report also indicated that persistent, new or recurring health problems were reported in 60% of children who had reported PCCs at 90 days. The most common reported symptoms were respiratory (eg, cough, difficulty breathing, or shortness of breath) and systemic (general fatigue and fever). (38) The report also indicated that the main risk factors for reporting PCCs included the number of acute symptoms, length of hospitalization, and older age of child.

Epidemiology

Prevalence and incidence

The prevalence of long COVID is difficult to establish for a range of reasons, including: (8, 39, 40)

- Studies of long COVID have used different measurement criteria and different inclusion criteria, so they cannot be reliably compared. Studies also often differ in the way they collect data.
- Studies have focused on different groups of people, different symptoms, and time intervals, and used different sample sizes.
- Most studies report the frequency of at least one symptom (not necessarily the same symptom), rather than a cluster of symptoms.
- Published studies may not be representative of everyone who has long COVID, especially with individuals of different cultures and ethnicities considered within samples. New Zealand specific samples need to include Māori, Pacific peoples, people with disabilities, older adults and those living in remote and rural communities.

- Difficulties in accessing COVID-19 testing in different countries may mask the true number of long COVID cases if studies require testing confirmation of the initial infection. In addition, testing policies vary between countries.
- The ways in which responses are elicited can impact estimated prevalence (e.g., app users are self-selected and responsible for recording symptoms, which can result in sampling and recording biases). In addition, many studies use retrospective self-reported symptoms.
- Some tools validated for other diseases may not be appropriate for use in long COVID patients.
- The prevalence of long COVID may also vary greatly depending on the groups studied (for example, app users vs population studies vs studies of patients who were hospitalised).
- The definition of long COVID currently is linked to over 200+ symptoms (41) therefore, studies must have sufficiently large populations to be representative of the range of long COVID symptoms. Otherwise, it is unlikely that estimates of prevalence and incidence will be accurate (link).
- The method of diagnosis of long COVID in national databases also currently appears to rely on self-classification and self-reporting.
- Despite these limitations, there is increasing evidence that a significant proportion of people experience long COVID, and there are concerns that these long-term effects may occur on a scale that "could overwhelm existing health care capacity, particularly in low- and middle-income countries."(17)

Please see the below table for an overview of prevalence estimates from some key sources, systematic reviews, and meta-analyses.

Paper	**Population / Aim/ Number of studies**	**Key findings**
Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 4 August 2022. The Office for National Statistics UK.	1.8 million people (self-reported)	An estimated 1.8 million people living in private households in the UK (2.8% of the population) were experiencing self-reported long COVID (symptoms persisting for more than four weeks after the first suspected coronavirus infection that were not explained by something else) as of 2 July 2022. This figure is based on symptoms and not a clinical diagnosis, and only 1.4 million (81%) had had COVID-19 at least 12 weeks previously.
A systematic review and meta-analysis published in mid-April 2022(42): Chen, C., et al., *Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review.* The Journal of Infectious Diseases, 2022.	50 studies were included and 41 were part of the meta-analysis.	As of 16 April 2022, the global estimated pooled prevalence of post COVID-19 condition was 0.43 (95% CI: 0.39,0.46), or 200 million individuals. - Regional prevalence estimates were Asia— 0.51 (95% CI: 0.37,0.65), Europe— 0.44 (95% CI: 0.32,0.56), and North America— 0.31 (95% CI: 0.21,0.43). -Global prevalence for 30, 60, 90, and 120 days after infection were estimated to be 0.37 (95% CI: 0.26,0.49), 0.25 (95% CI: 0.15,0.38), 0.32 (95% CI: 0.14,0.57) and 0.49 (95% CI: 0.40,0.59), respectively. -Hospitalised and non-hospitalised patients had estimates of 0.54 (95% CI: 0.44,0.63) and 0.34 (95% CI: 0.25,0.46), respectively.

Paper	Population / Aim/ Number of studies	Key findings
		- Denmark has the highest estimate of Long COVID-19 per 100,000 people (defined in this case as at least one symptom of COVID-19 up to 120 days after infection), with 23,558, followed by Andorra (23,329), and Israel (23,194). -The United States has the highest absolute number of Long COVID-19 cases, with 25,141,186, followed by India (22,824,713), and France (12,526,469).
Systematic review and meta-analysis published in August 2021 (8): Lopez-Leon, S., et al., *More than 50 long-term effects of COVID-19: a systematic review and meta-analysis.* Scientific Reports, 2021. **11**(1): p. 16144.		Estimated that the number of people with SARS-CoV-2 who developed one or more long-term symptoms could be as high as 80% of patients.
October 2021 systematic review (17): Groff, D., et al., *Short-term and Long-term Rates of Post-acute Sequelae of SARS-CoV-2 Infection: A Systematic Review.* JAMA Network Open, 2021. **4**(10): p. e2128568-e2128568.	The mean age was 54.4 years, and 79% were hospitalised during acute COVID-19. High-income countries contributed 79% of the studies.	The median (IQR) proportion of COVID-19 survivors experiencing at least 1 post-acute sequelae of COVID-19 (PASC) was 54.0% (45.0%-69.0%; 13 studies) at 1 month (short-term), 55.0% (34.8%-65.5%; 38 studies) at 2 to 5 months (intermediate-term), and 54.0% (31.0%-67.0%; 9 studies) at 6 or more months (long-term). That is, more than half of COVID-19 survivors experienced PASC 6 months after recovery.
Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ (2021) Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLoS Med 18(9): e1003773. (43)	A retrospective cohort study based on linked electronic health records (EHRs) data from 81 million patients including 273,618 COVID-19 survivors.	Among COVID-19 survivors (mean [SD] age: 46.3 [19.8], 55.6% female), 57.00% had one or more long-COVID feature recorded during the whole 6-month period (i.e., including the acute phase), and 36.55% between 3 and 6 months. Findings showed that the highest prevalence is in Asia, followed by Europe and North America. The data is limited due to being self-reported with the studies definitions of long COVID varying from 4 to 12 weeks.

Paper	Population / Aim/ Number of studies	Key findings
Long COVID: Household Pulse Survey. CDC	US Census Bureau survey	40% of the total adult population has contracted COVID-19, and from this population, the estimated prevalence of long COVID (ongoing symptoms for three months or longer) is 1 in 5 adults.
Zeng, N., Zhao, YM., Yan, W. et al. A systematic review and meta-analysis of long term physical and mental sequelae of COVID-19 pandemic: call for research priority and action. Mol Psychiatry (2022).(44) https://doi.org/10.1038/s41380-022-01614-7	A meta-analysis of survivors' health consequences and sequelae for COVID-19. A total of 151 studies were included involving 1,285,407 participants from thirty-two countries.	At least one sequelae symptom occurred in 50.1% (95% CI 45.4-54.8) of COVID-19 survivors for up to 12 months after infection. The most common investigation findings included abnormalities on lung CT (56.9%, 95% CI 46.2–67.3) and abnormal pulmonary function tests (45.6%, 95% CI 36.3–55.0), followed by generalised symptoms, such as fatigue (28.7%, 95% CI 21.0–37.0), psychiatric symptoms (19.7%, 95% CI 16.1–23.6) mainly depression (18.3%, 95% CI 13.3–23.8) and PTSD (17.9%, 95% CI 11.6–25.3), and neurological symptoms (18.7%, 95% CI 16.2–21.4), such as cognitive deficits (19.7%, 95% CI 8.8–33.4) and memory impairment (17.5%, 95% CI 8.1–29.6). The findings suggest that after recovery from acute COVID-19, half of survivors still have a high burden of either physical or mental sequelae up to at least 12 months.
A global systematic analysis of the occurrence, severity, and recovery pattern of long COVID in 2020 and 2021 (45) https://doi.org/10.1101/2022.05.26.22275532	10 ongoing cohort studies in 10 countries. They pooled data from the contributing studies, two large medical record databases in the United States, and findings from 44 published studies using a Bayesian meta-regression tool. Analyses are based on detailed information for 1906 community infections and 10526 hospitalized patients from the ten collaborating cohorts, three of which included children.	Globally, in 2020 and 2021, 144.7 million (95% uncertainty interval [UI] 54.8–312.9) people suffered from any of the three symptom clusters of long COVID. This corresponds to 3.69% (1.38–7.96) of all infections. The fatigue, respiratory, and cognitive clusters occurred in 51.0% (16.9–92.4), 60.4% (18.9–89.1), and 35.4% (9.4–75.1) of long COVID cases, respectively. Those with milder acute COVID-19 cases had a quicker estimated recovery (median duration 3.99 months [IQR 3.84–4.20]) than those admitted for the acute infection (median duration 8.84 months [IQR 8.10–9.78]). At twelve months, 15.1% (10.3–21.1) continued to experience long COVID symptoms.

Prevalence of long COVID in Aotearoa New Zealand

At this time the prevalence of long COVID in Aotearoa New Zealand is unknown. However, preliminary results from the Ngā Kawekawe o Mate Korona study suggest that the prevalence may vary across groups. Importantly, participants in this study were self-selected into the study. Furthermore, there was an emphasis on recruiting Māori participants, and therefore for these reasons it is not possible to draw firm conclusions regarding prevalence. The researchers reported that of 65 Māori participants, 43% (N=28) reported symptoms for more than one month, and of these participants, 75% (N=21) reported experiencing long COVID symptoms for more than three months post-infection. In comparison, of the 405 participants who were non-Māori, 47% (N=190) reported symptoms for more than one month, and of these individuals, 65% (N=124) reported symptoms which lasted more than 3 months (link). While similar proportions reported ongoing symptoms overall, slightly more Māori participants reported symptoms for three months or longer.

Aetiology

Long COVID is complex and there is likely to be more than one mechanism that contributes to its development. Evidence continues to emerge on the molecular contributors to long COVID, which may inform advice for management and treatment. SARS-CoV-2 is not just a virus that affects the respiratory system; it can cause widespread tissue damage and inflammation, leading to multisystem disruption, systemic inflammation, and immune dysfunction. (46, 47) As described in a Goodfellow Unit webinar in April 2022, there are currently four broad theories as to what causes long COVID symptoms. (47) These factors are not mutually exclusive[4], and include:(47)

1) **Persistent virus or viral antigens causing chronic inflammation:** In some patients, SARS-CoV-2 viral antigens can be found in tissue months after acute infection. For example, one study reported expression of SARS-CoV-2 RNA in the gut mucosa ~7 months after mild acute COVID-19 in 32 of 46 patients with inflammatory bowel disease. (48) Post acute COVID-19 symptoms were reported from the majority of patients (66%) with viral antigen persistence, but not from patients without viral antigen persistence. It was not possible to culture virus in any participants. Additionally, a pre-print case study with two long COVID patients, found viral antigen in the breast and appendix tissue at 6 and 15 months following infection. There was also evidence of negative strand RNA which is indicative of ongoing replication. It was noted however that live virus was not able to be cultured in these patients. (49)

2) **Autoimmunity triggered by SARS-CoV-2 infection:** Autoantibodies have been found in some patients with long COVID. However, determining the significance of these can be difficult as some may be involved in the disease process and some may be non-functional 'bystanders'. There is some evidence that patients who are better at making antibodies against SARS-CoV-2 are less likely to have autoantibodies detected. It is also unclear whether the autoantibodies were triggered by COVID-19 or whether they were there prior and only now became evident. Looking at antibody

[4] For example, patients may have some degree of any or all of these contributing factors. It is possible there may be some sub-groups of patients in which one factor is more important than others. It is also possible that the relative importance of these factors could vary depending on the strain of the virus.

isotypes can provide insights. Auto-antibodies can preceed disease by months or years so this may be a way to identify patients at higher risk of long COVID. (50)

3) **Dysbiosis (changes in the microbiome) and viral reactivation (reactivation of viruses other than SARS-CoV-2 in the context of COVID-19 infection):** These are two ways that microbes outside of SARS-CoV-2 may plausibly contribute to long COVID. A number of studies investigating what happens in the microbiome (especially oral) of patients with long COVID have found decreased microbial diversity, increased pathogenic bacteria and decreased beneficial bacteria. In terms of viral reactivation, work is underway to look at whether reactivation of EBV or other herpes viruses may contribute to long COVID. (51)

4) **Unrepaired tissue damage from the original infection (including endothelial dysfunction)**: A study performed in hamsters found that SARS-CoV-2 infection resulted in pathologies leading to long COVID. The study found when compared to Influenza A, SARS-CoV-2 had a greater likelihood to permanently damage the lungs and kidneys and impacted both the olfactory bulb and epithelium of the hamsters. A month after viral clearance, within the olfactory bulb and epithelium there was activation of T-cells and myeloid cells, production of proinflammatory cytokines and interferon responses. These responses were correlated to behavioural changes including increased compulsive behaviours and anxiety. (52) These sustained transcriptional changes could also be corroborated from tissue isolated from individuals who recovered from COVID-19. These data highlight a molecular mechanism for persistent COVID-19 symptomology and provide a small animal model to explore future therapeutics linked to the onset of long COVID. However, the link between the severity of symptoms, degree of cellular damage and the impact this has on risk of developing long COVID will require further research. (47)

More research is needed to better understand the potential immunological mechanisms contributing to the development of long COVID. Some people with long COVID are experiencing similar symptoms to myalgic encephalomyelitis / chronic fatigue syndrome (ME/CFS), which has been noted after other viral infections such as SARS-CoV-1 and MERS (Middle East Respiratory Syndrome). (53) There is a similar pattern of long-term illness being triggered by acute infection by these viruses in some people. (54) Current research suggests that cellular damage and inflammation from these viral infections is linked to symptoms similar to ME/CFS. There is continued research underway to investigate how long COVID may be related to other post-viral conditions.

Risk Factors

There is a growing body of evidence about which groups are at greatest risk of developing persistent symptoms. A study published in June 2022 investigated long COVID burden and risk factors in 10 UK longitudinal studies and electronic health records. Increasing age, female sex, white ethnicity, poor pre-pandemic general and mental health, overweight/obesity, and asthma were associated with prolonged symptoms in both sources of data. (55)

Long COVID appears to be more common among people who have severe COVID-19 symptoms during acute illness but can also affect those who initially had mild or moderate COVID-19. Even people who initially had no symptoms may go on to develop long COVID.(56) Long COVID is seen in all age groups, however, it appears to be less common in children and adolescents than in adults.

Some factors that may be associated with increased chance of having long COVID symptoms have been identified, and these include:

- older age (4, 11, 57) (link)
- having more than one underlying chronic medical condition or pre-existing conditions (57)
- a higher body mass index (obesity) (57)
- being female (57-59)(link)
- hospitalisation during acute COVID-19 (60)
- multiple early symptoms (61, 62)
- SARS-CoV 2 variant type.(18)

Data from the UK Coronavirus (COVID-19) Infection Survey (7 July) indicates that as a proportion of the UK population, the prevalence of self-reported long COVID was greatest in people aged 35 to 69 years, females, people living in more deprived areas, those working in social care, health care, or teaching and education, and those with another activity-limiting health condition or disability. (link) In the UK's Coronavirus (COVID-19) Infection Survey, prevalence of self-reported long COVID was greatest in people aged 35 to 49 years, females, people living in more deprived areas, those working in social care, teaching and education or health care, and those with another activity-limiting health condition or disability. Notably, this was self-reported rather than from clinical diagnosis. (link) A review published in June 2022(59) found that the likelihood of having long COVID syndrome was significantly greater among females (OR = 1.22; 95% CI: 1.13–1.32) The authors commented that if an elevated immune response is involved in long COVID, this may be a potential explanation for why long COVID appears to be more common in female patients.(59) Research indicates that females mount faster and more robust immune responses, and sex differences in immune response have also been reported in other viral and bacterial infections with chronic sequelae.(59)

Other factors that may immunologically predispose people to a greater risk of long COVID have been noted,(61) and these include having a greater viral load during early stages of infection, the presence of autoantibodies, (63) imbalances or compositional alterations in gut microbiome,(63, 64) and vaccination status.(65) Previous Epstein-Barr infection or a reactivation of latent viruses during initial infection has also been noted.(63, 66)

Recent studies have found that there is a correlation between COVID-19 variant type and the risk of developing long COVID. A UK based study published in June has indicated that the risk of developing long COVID from Omicron (4.4%) is roughly half the risk from Delta infections (10.8%).(18) These studies do however note the risk of developing long COVID still remains of significant concern as the rising Omicron incidence rates indicate that the absolute numbers of people with long COVID will be large, and therefore a burden on the health system.

Prevention

Much of the discussion on prevention of long COVID currently focuses on the role of vaccination. Collectively, findings from various early studies suggest that vaccination against COVID-19 might reduce the population prevalence of long COVID by reducing the risk of: (a) continuing to experience persistent symptoms in those who already have symptoms when vaccinated; (b) developing persistent symptoms

after breakthrough infections; (c) being infected in the first place; and (d) transmitting the virus after infection. (67) However, vaccination before infection likely confers only partial protection against development of long COVID, and so reliance on it as a sole mitigation strategy may not optimally reduce long-term health consequences of SARS-CoV-2 infection. (60)

Other contributors to prevention of long COVID are not well studied, however it is widely accepted that resting during the acute COVID infection phase and living a generally healthy lifestyle are likely to help recovery from COVID-19 and may prevent long COVID.

Vaccination

The effectiveness of vaccination against long COVID is a critical area of research, but significant uncertainties remain. Much of the evidence to date points to a protective effect of vaccination. However, the lack of randomised controlled trials and predominance of observational studies mean that causality cannot be easily determined (67) and it is difficult to truly know the effect of vaccination. A BMJ editorial published in May 2022 notes that benefits of vaccination against long COVID are possible, but more evidence is needed, along with a mechanism of action. (68) Early research suggests that long COVID symptoms are less common following breakthrough infections, but the effectiveness of vaccination on pre-existing long COVID is less clear. (67)

A key resource on the topic at this time is a review by the UK Health Security Agency (UKHSA), which was published in February 2022. (69) The review included 15 observational studies published up until mid-January 2022. Overall, the review indicated that people who have had one or more doses of a COVID-19 vaccine are less likely to develop long COVID than those who remain unvaccinated. (70) However, as all the studies were observational, it is possible that differences other than vaccination may contribute to the results. In addition, the definition of long COVID varied between studies. (71)

Another review (July, 2022) evaluated differences between various COVID-19 vaccine types and whether the vaccines used has an impact on long COVID outcomes. This review also showed most studies has reported vaccination led to participants being less likely to develop long COVID (67, 68, 72, 73) or to experience an improvement to long COVID symptoms, however two studies still reported vaccination as increasing the risk of long COVID. (72, 74) Most studies did not find any difference in efficacy between vaccine types. (74) However one study (April, 2022) found a significant difference in the symptoms of long COVID reported by participants that received Moderna vaccine, compared to AstraZeneca, with more reporting fatigue, myalgia and chest pain in the Moderna cohort. (74, 75) Due to the observational nature of this study, better randomised controlled trials would be required to more definitively identify differences between vaccination types, however a trial such as this would be difficult due to the high rates of vaccination now.

In Aoteaora New Zealand, Māori may have an increased risk of developing long COVID given the higher rates of COVID-19 in this group, and lower vaccination rates. The potential inequitable impact of long COVID on Māori is concerning and is receiving recent media attention (link).

The impact of vaccination prior to infection on long COVID

UKHSA collated evidence from eight studies which investigated the effectiveness of vaccination against long COVID prior to infection.(69) Findings from six of the eight studies suggested that vaccinated people (those who have had one or two doses) were less likely to develop symptoms of long COVID following infection compared with unvaccinated people.(71) This was seen in short (4 weeks), medium (12-20 weeks), and long

(6 months) term timeframes after infection. In two of the eight studies, participants that were fully vaccinated were less likely to report the following symptoms in the medium to long term: fatigue, persistent muscle pain, headache, hair loss, weakness in arms and legs, shortness of breath, dizziness, anosmia, interstitial lung disease, myalgia and other pain.(69) As all eight of the studies only included participants who had COVID-19, the effect of vaccination on reduced incidence of COVID-19 is not accounted for. Therefore the studies likely underestimate the effectiveness of vaccines to prevent long COVID.

A review (July 2022) had the following table summarising studies that investigated the effects of vaccination on long COVID in patients that were vaccinated prior to a COVID-19 infection. A table taken from this review is shown below. (74) In this it shows Simon et al. (76) reported that vaccination significantly decreased the risk of developing long COVID symptoms after just a single dose. This was also seen in Antonelli et al. where a population that received two doses were half as likely to have symptoms after 28 days. (65) In contrast Tarquet et al. found no difference in long COVID prevalence between people who were vaccinated prior to infection and an unvaccinated control group. (77)

Table 2. Effects of vaccination on long COVID in patients who were vaccinated before getting infected with COVID-19.

Author	Total Participants	Vaccinated (*n*)	Vaccine Used	Single Dose (*n*)	Double Dose (*n*)	Participants Who Developed COVID-19 (*n*)	Participants Who Developed Long COVID-19	Differences between Vaccines	Vaccination Effects on Long COVID	Symptoms Effected
Antonelli et al. [18]	4740	2370	(Pfizer, Astrazeneca Moderna)	-	2370	not specified	50% less than those with one dose or unvaccinated	None	Half as likely to have symptoms > 28 days	Respiratory, ENT, MSK, CVS, GI, Neurological, Psychiatric, Fever, Fatigue
Taquet et al. [19]	18,958	9479	65.1% were vaccinated with 'Pfizer/BioNTech', 9.0% with Moderna, 1.6% with Janssen', and 24.4% with unspecified subtype	N/A	N/A	not specified	N/A	no outcomes on long COVID	Less likely to exhibit 5 symptoms of long COVID	Anosmia, Fatigue, Hairloss, Myalgias, ILD
Simon et al. [20]	240,648	20,188	Pfizer, Jansen, Moderna	2392	17,796	not specified	90,319	not reported	Less likely to have any symptom of long COVID (OR 0.22)	Respiratory, ENT, MSK, CVS, GI, Neurological, Fever, Fatigue
Blumberg et al. [21]	43	15	Pfizer	2	13	not specified	not specified	N/A	Less likely to have symptoms of long COVID.	Respiratory, CVS
n (Total)	*n* = 264,389	*n* = 32,052								

N/A: not applicable.

Figure: Image from Mumtaz et al. (74). References in the image relate to the following 18 =(65), 19=(77), 20=(76) , 21= (78).

A UK nested case-control study (65) included in the UKHSA review (deemed medium quality) found that fully vaccinated participants were approximately half as likely to have symptoms lasting at least 28 days as unvaccinated participants.(71) However, no statistically significant benefit was found for those who were partially vaccinated compared to those who were unvaccinated. The UK Office for National Statistics reported similar results in January 2022 (based on data to 30 November 2021). In a sample of UK adults aged 18-69 years, receiving two doses of a COVID-19 vaccine was associated with a 41.1% decrease in the odds of self-reported long COVID at least 12 weeks later (compared to socio-demographically similar study participants who were not vaccinated when infected).

A research letter (July 2022) reported on an observational cohort study of workers from nine Italian healthcare facilities. (79) Data was collected from March 2020 to April 2022, where the workers were tested every 1 or 2 weeks to identify symptomatic and asymptomatic COVID-19 infections. All workers were required to receive 3 doses of the Pfizer vaccine with a clearly defined dosing schedule (first and second doses January-Feburary 2021 and booster November-December 2021). All participants completed a survey which included a list of SARS-CoV-2 symptoms during infection, co-morbidities, and other demographics. The study defined long COVID as one or more SARS-CoV-2 symptom after 4 weeks. People hospitalised from COVID were also excluded to avoid any bias related to severe disease. Of the 2,560 patricipants, 739 (29%) had a COVID-19 infection, including 89 asymptomatic infections. From the participants that had a COVID-19 infection, 229 (31%) presented with long COVID.This long COVID prevalence was different between waves, with 48.1% in wave one, 35.9% in wave 2 and 16.5% from wave 3. The number of vaccination doses was associated with the prevalence of long COVID, with a 41.8% prevalence in unvaccinated patients, 30.0% after 1 dose, 17.4% after 2 doses and 16.0% after 3 doses. Additionally, older age, higher BMI, obstructive lung disease and allergies were associated with long COVID. A limitation to this study was that COVID duration and symptoms were self-reported. Additionally, the exclusion of hospitalised patients means that these conclusions do not represent people who had severe disease. (79)

There continues to be no data in children about the level of protection provided by vaccination against the incidence of long COVID (in addition to protection against infection) in those who have become infected after vaccination.

The impact of vaccination after infection on long COVID

It is widely recommended that after a COVID-19 infection, people should start or continue their vaccination schedule after 3 months from diagnosis with the acute illness, to allow for some time for recovery.

The effect of vaccination on pre-existing long COVID remains uncertain and contentious, as published studies have generally been small and with self-selected participants. (68) Anecdotal reports and some studies (69, 80) suggest a range of experiences following COVID-19 vaccination ranging from improvement, deterioration, and no change in long COVID symptoms. In the UKHSA review, 3 of 4 studies comparing long COVID symptoms before and after vaccination suggested that more cases reported an improvement in symptoms after vaccination, either immediately or over several weeks. (69) However, some cases in all studies did report a worsening in symptoms after vaccination. (69) In three of the five studies reporting on symptom changes following vaccination of people with long COVID, there was a higher proportion of people with long COVID who reported unchanged symptoms following vaccination (up to 70%) than people whose symptoms improved or worsened. (69)

Some studies have suggested that vaccination after infection can significantly reduce the likelihood of long COVID. For example, a large study which analysed self-reported data from 1.2 million UK smartphone users found that two doses of a COVID-19 vaccine halved the risk of long COVID. (65) However, some recently published studies suggest that the protective effect may not be as great as initially thought. (81)

A large study published in *Nature Medicine* in May 2022 used the US Veterans Affairs databases for an analysis that included more than 13 million people.(60) This reported that vaccination lowers the risk of long COVID after infection by about 15%.(81) Symptoms such as brain fog and fatigue were compared in vaccinated and unvaccinated participants for up to six months after they tested positive for SARS-CoV-2. No difference was found in the type or severity of symptoms between vaccinated and unvaccinated groups. Limitations of this study are the relatively small numbers of women included and suboptimal schedules for

vaccination. (79) Additionally, this was completed prior to the emergence of Omicron and its sublineages so may not be representative of current circulating variants.

The UKHSA rapid evidence briefing also reported on 3 studies which compared people with long COVID who were infected with SARS-CoV-2 and then subsequently vaccinated, to participants with long COVID that remained unvaccinated following infection. All three studies reported that the cohort who received the vaccinations were significantly less likely to experience long COVID symptoms shortly after vaccination and over longer periods. (69)

One of the largest studies on this topic to date (published May 2022) is a community-based cohort study of 28,356 participants (mean age 46 years, 56% female, 89% white) from the UK's COVID-19 Infection Survey examined the trajectory of long COVID symptoms following COVID-19 vaccination. Participants were aged 18 to 69 years who received at least their first vaccination after test-confirmed infection. The study had a median follow-up of 141 days from first vaccination (among all participants) and 67 days from second vaccination (84% of participants). The principal finding was a decrease in the likelihood of experiencing long COVID symptoms after a second vaccine dose. First vaccination was associated with an initial 12.8% decrease (95%CI: −18.6% to −6.6%) in the odds of long COVID but increasing by 0.3% (−0.6% to +1.2%) per week after the first dose. Second vaccination was associated with an 8.8% decrease (−14.1% to −3.1%) in the odds of long COVID, with the odds subsequently decreasing by 0.8% (−1.2% to −0.4%) per week. There was no statistical evidence of heterogeneity in associations between vaccination and long COVID by socio-demographic characteristics, health status, whether hospitalised with acute COVID-19, vaccine type (adenovirus vector or mRNA), or duration from infection to vaccination.(67) Similar findings to this have been reported in multiple other studies. (82, 83)

As part of a federated research study with the COVID-19 Patient Recovery Alliance, Arcadia Data Research (Arcadia.io) performed a retrospective analysis of the medical history of 240,648 COVID-19-infected persons to identity factors influencing the development and progression of long COVID. Data were captured directly from electronic health record (EHR) systems, practice management systems. This analysis revealed that patients who received at least one dose of any of the three COVID vaccines available in the US (Pfizer, Modern or Janssen) prior to their diagnosis with COVID-19 were 7-10 times less likely to report two or more long-COVID symptoms compared to unvaccinated patients. Furthermore, unvaccinated patients who received their first COVID-19 vaccination within four weeks of SARS-CoV-2 infection were 4-6 times less likely to report multiple long-COVID symptoms, and those who received their first dose 4-8 weeks after diagnosis were 3 times less likely to report multiple long COVID symptoms compared to those who remained unvaccinated. The study authors argue that this relationship supports the hypothesis that COVID-19 vaccination is protective against long COVID and that effect persists even if vaccination occurs up to 12 weeks after COVID-19 diagnosis. (76)

Additionally, one small study with 44 vaccinated and 22 matched unvaccinated participants, assessed the timing of vaccination following COVID diagnosis in people that were hospitalised. This study found that in both vaccinated and unvaccinated people following infection, most people (up to 70%) reported no change to long COVID symptoms after vaccination. (72) Additionally, it concluded that people who were vaccinated sooner were likely to report less long COVID symptoms than unvaccinated people. However, in the vaccinated cohort, 23.2% (n=10) reported symptoms of long COVID to be improving compared to 15.4% (n=3) in the unvaccinated. Additionally, 14.3% reported symptoms of long COVID to be worsening in the unvaccinated, while only 5.6% of the vaccinated cohort reported this. Overall, this study concluded that

vaccination led to no worsening of symptoms or quality of life with some statistically significant improvements. (72)

A study in the UK surveyed 900 people living with long COVID and evaluated the impact of their first COVID-19 vaccination on their symptoms. In this, 57.9% of people reported an improvement to symptoms, 24.2% no change and 17.9% reported deterioration. The report also stated that people who received mRNA vaccines tended to report larger levels of improvement compared to adenovector vaccines. This is the largest survey to date of people living with long COVID, however due to the self-reporting nature of the survey, it is noted that a randomised controlled trial would be required to confirm any direct links between that observed between vaccination and improvement to long COVID symptoms. (82)

A review (July 2022) had the following table summarising studies that investigated the effects of vaccination on long COVID in patients that were vaccinated after a COVID-19 infection. (74) In the table it reported that nine studies indicated vaccination likely improves the effects of long COVID, one saw a negative association, one saw mixed results depending on the symptoms, and one saw no association between vaccination after infection and long COVID.

Table 1. Effects of vaccinations on pre-existing COVID-19 symptoms.

Author	Total Participants	Vaccine Given	Unvaccinated (*n*)	Vaccinated (*n*)	Single Dose (*n*)	Double Dose (*n*)	Participants Who Developed Long COVID (*n*)	Differences between Vaccines Reported	Vaccination Effects on Long COVID	Symptoms Effected
Arjun et al. [6]	487	Covaxin	119	368	81	287	142	N/A	More likely to develop long COVID symptoms (aOR = 2.32)	Fatigue, Fever, Chills, ENT, Respiratory
Arnold et al. [7]	66	Pfizer, AstraZeneca	22	44	N/A	N/A	66	no difference	50% less likely to develop long COVID symptoms	Respiratory, ENT, MSK, CVS, GI, Neurological Fatigue
Ayoubkhani et al. [8]	28,356	Pfizer, Moderna, Adenoviral vector vaccine	0	28,356	N/A	N/A	6729	no difference	Less likely to develop all long COVID symptoms (OR = 0.91)	Respiratory, ENT, MSK, CVS, GI, Neurological, Psychiatric, Fever, Fatigue
Gaber et al. [9]	77	Pfizer, Moderna	10	67	-	-	-	no difference	Less likely to develop 1 or more long COVID symptoms	Fatigue, Anxiety, Shortness of Breath
Kuodi et al. [10]	951	Pfizer, Moderna	317	634	340	294	337	-	36–73% less likely to develop long COVID symptoms	Fatigue, headache, MSK, DErmatological, insomnia, LOC
Nehme et al. [11]	1596	Pfizer, Moderna	825	771	424	347		no difference	Less likely to develop any one symptom (aOR 0.60)	Fatigue, Neurological, ENT, Respiratory
Peghin et al. [12]	479	Pfizer, Moderna, Astrazeneca Johnson & Johnson	347	132	N/A	N/A	201	no difference	More likely to develop ocular symptoms, less likely to develop hair loss	Hair Loss, Ocular symptoms
Scherlinger et al. [13]	567	Pfizer, moderna, Adenoviral vector vaccine	170	397	255	142	380	no difference	22% of patients felt an improvement in long COVID Symptoms	Respiratory, GI, Neurological, CVS, Psychiatric, MSK, ENT, Pruritis, Bruising, Fever, Chills
Senjam et al. [14]	773	N/A	407	366	173	193	0	N/A	Less likely to develop long COVID symptoms	ENT, Neurological, MSK, Dermatological, Fatigue, Respiratory

Table 1. *Cont.*

Author	Total Participants	Vaccine Given	Unvaccinated (*n*)	Vaccinated (*n*)	Single Dose (*n*)	Double Dose (*n*)	Participants Who Developed Long COVID (*n*)	Differences between Vaccines Reported	Vaccination Effects on Long COVID	Symptoms Effected
Strain et al. [15]	812	Astrazeneca, Pfizer, Moderna	0	812	698	114	812	MRNA superior	57% of participants reported an improvement in symptoms	Respiratory, ENT, MSK, CVS, GI, Neurological, ANS dysfunction, Rash, Fever, COVID toes
Tran et al. [16]	910	Pfizer, Moderna, Astrazeneca, Johnson & Johnson	455	455	N/A	N/A	not specified	no difference	More likely to experience remission of all long COVID symptoms (HR = 1.97)	Respiratory, ENT, MSK, CVS, GI, Neurological, Dermatological, ANS dysfunction, Psychiatric, Fatigue
Wisnivesky et al. [17]	453	Pfizer, Moderna, Jansen	129	324	N/A	N/A	not specified	no difference	No association	
	n = 35,527		*n* = 2801	*n* = 32,726			*n* = 8667			

N/A: not applicable.

Figure: Image from Mumtaz et al. (74). References in the image relate to the following for this documents: 6=(84),7= (72), 8= (67), 9= (85),10= (86), 11=(87), 12=(88), 13=(89), 14=(90), 15=(82), 16=(83), 17=(91).

Vaccine injury

There has been some discourse suggesting vaccine injury may lead to long COVID symptoms. A news article published in Science (Jan, 2022) discussed the experience on an individual. who received a dose of AstraZeneca vaccine as part of a clinical trial, having never had COVID-19. (92) By the evening she became disorientated and had blurred vision. Her multiple symptoms rapidly worsened, including heart rate fluctuation. Eventually she spent most of her time in a darkened room, with little energy for basic tasks such as brushing her teeth. As a result, she was diagnosed by her doctor with anxiety. (92)

By January 2021, the National Institute of Health (NIH) began to receive more reports like this. Some small-scale research has been undertaken however it was inconclusive in its findings relating to whether the vaccine may be causing rare and lasting health problems in some people. Avidra Nath, the clinical director at the National Institute of Neurological Disorders and Stoke reported that the the people had "temporal association" between their faltering health and vaccination, however it was unclear if there was "an etiological association." In general, the was a correlation, but no defined causation between the vaccination and the long COVID symptoms. (92)

Other preventions – a holistic approach to long COVID

Although it is largely agreed that the best way to prevent long COVID it to prevent the initial SARS-CoV-2 infection itself, more information is required to truly understand how to prevent long COVID after infection has occurred. Other strategies in prevention of Long COVID are not well studied, however it is generally accepted that resting during the recovery of acute infection and healthy lifestyle can help recovery viral infections. Given the range of symptoms and general lack of understanding in the mechanisms leading to long COVID, many experts believe a "holistic" approach with personal care, relevant to the patient is the best way to prevent it. A community-based study, completed in France 2020, indicated that an interaction between long COVID and smoking. (93)

The association between long COVID and other post-viral conditions

As long COVID has emerged, many health care professionals and researchers have compared the experience to other post-viral conditions such as myalgic encephomyelitis/ chronic fatigue syndrome (ME/CFS) due to the similarities in symptoms and affected demographic, and therefore many researchers are postulating that long COVID may be a sub-type of ME/CSF. (94) Of note people with ME/CSF experience symptoms of fatigue, brain fog, headaches, pain in organs and tissues, and disturbances of the autonomic nervous system which regulates functions such as blood pressure, respiration, digestion, and sleep. (94)

ME/CFS has a history of being maligned and neglected by medical establishments, likely due to the complicated presentation of symptoms and poorly defined aetiology. (94) There remain multiple case definitions of ME/CFS and relatively little research has been carried out on it. Until recent years, ME/CFS research and medical care suffered from many believing it to be a psychosomatic illness. Recent studies have now debunked this idea and molecular studies have identified it to be a complex biomedical illness that involves an immune system dysfunction. (94)

In New Zealand, research by University of Otago Emeritus Professor Warren Tate has mapped key changes in important physiological and biochemical pathways and systems in ME/CSF patients. The molecular level changes can be used to explain the diverse symptoms and ongoing disease course. Tate has been awarded funding from Brain Research New Zealand, which is being used to compare the molecular signals in people diagnosed with ME/CSF with those with long COVID. (94) Additionally, research by New Zealand Immunologist, Dr. Anna Brooks, based at the University of Auckland is also studying the 'immunity and molecular studies of SARS-CoV-2 infection, post-viral conditions and COVID-19 vaccination'. Both Brooks and Tate hope to determine if the two disease share common biomarkers. (94)

Impacts

Psychosocial impacts

The functional impairment experienced by some people with long COVID and the toll managing symptoms has on quality of life is becoming clearer. An early patient-led study of 3,762 self-described long haulers in 56 countries found 45.2% (42.9% to 47.2%) reported requiring a reduced work schedule compared to pre-illness and 22.3% (20.5% to 24.3%) were not working at the time of the survey due to their health conditions.(41)

Long COVID patients are reporting multiple psychosocial impacts, including mental health related impacts. This includes reporting experiences of feeling depressed, anxious, or worried. (95) Another article considering guidance to support patients experiencing long COVID found several specific mental health challenges, including: post-traumatic stress disorder (PTSD), major depressive disorder, anxiety disorders, sleep disorders, phobias, fears with avoidant behaviours, health anxieties, obsessive-compulsive disorder (OCD) and adjustment disorder related to living with long COVID-19 symptoms, social exclusion and addictions (as a form of coping), and neuropsychiatric disorders.(96) In the Ngā Kawekawe o Mate Korona study, 43% of Māori and 52% of non-Māori reported not feeling understood by their healthcare professional, and 61% and 76% respectively reported having concern about not knowing when their symptoms would end (link).

Overall, long COVID is having an impact on reported quality of life. An online survey study completed in 2021 found an overall reduction in quality of life, and this was due to a range of the symptoms reported which included sleep quality, breathlessness, physical activity and mental health. (95)

Social and economic impacts

While the fiscal impacts of the COVID-19 pandemic in general is well known and reported on across jurisdictions, the fiscal impacts of long COVID specifically are less well known and scarcely reported on, as the impacts are hard to quantify given the wide variety of variables involved. The impact of long COVID can be looked at from multiple angles: from decreased productivity due to a reduction in workforce, to the costs incurred by an individual, including healthcare costs, lost wages, lost savings, and accrued debt.

Additionally, long COVID has had an impact on the ability of some patients to work. People with ongoing symptomatic COVID-19 or post-COVID-19 syndrome who report increased absence or reduced performance in education or work may need extra support and recovery time. (1) Long COVID therefore

limits the ability of people to return to work and to socialise, not only potentially further affecting their mental health, but also having economic consequences for them, their whānau and society. (5)

Preliminary analysis from Ngā Kawekawe o Mate Korona study has found that 45% of Māori with long COVID say their usual activities have been affected to a moderate or extreme level; about 20% have severe pain; and about 10% have difficulty moving (link).

The Solve Long COVID initiative, a non-profit research and advocacy group in the United States, has estimated that the disability caused by long COVID has cost $386 billion dollars in the United States alone. Only the personal financial impact on affected individuals was considered, like lost wages, lost savings, and healthcare costs, from the beginning of the pandemic through to January 31 2022 (link).

Further work to measure the financial impact of long COVID is still required to fully understand its scale. Countries across the globe have committed varying levels of financial resources to diagnose, understand and treat the condition, but research and reporting regarding the overall financial impact and the second and third order financial effects of long COVID is currently scarce.

The social and economic burden of long COVID will affect Māori and Pacific peoples to a greater degree, as they have accounted for a greater proportion of cases during Aotearoa New Zealand's Delta and Omicron outbreaks.

Diagnosis, Treatment, Management and Support

Diagnosis

There are currently several limitations and challenges in diagnosing long COVID, the most significant being the current lack of consensus on the definitions of long COVID (as is detailed above).

Although there are a wide range of symptoms that can present for long COVID, many of these symptoms are common from a multitude of other conditions, making them hard to decipher or confirm as long COVID. Additionally, ongoing symptoms may vary widely and will affect people in diverse ways, and symptoms can be diverse with multiorgan involvement. Long COVID is multi-factorial, and more than one mechanism may be implicated in clinical presentations. (97)

Compounding the lack of clear definitions, due to the relative newness of the condition, there may be a limited amount of knowledge of the condition known by many healthcare professionals.

There are currently no specific tests to aid in the diagnosis.

Preliminary analysis from the Ngā Kawekawe o Mate Korona study has found many patients have faced a number of healthcare access challenges in their long COVID journey, including:

- 32% of Māori and 49% of non-Māori reporting their doctor did not recommend or provide wraparound support
- 50% of Māori and 40% of non-Māori being unable to get good information about vaccines for people with long COVID
- 35% of Māori and 34% of non-Māori not being referred to a specialist, and 13% of Māori and 4% of non-Māori not having their specialist referral accepted
- 52% of Māori and 37% of non-Māori not knowing who to ask for help or support

- 48% of Māori and 44% of non-Māori not feeling listened to
- 32% of Māori and 43% of non-Māori reporting their doctor did not know what to do next (link).

Models of care

Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID. There is an emerging consensus therefore on best practice which points to the need for multidisciplinary, multispecialty approaches to assessment with case management tailored to how the disease manifests for each patient, (5) and an individualised management plan developed. (98) Some patients may find it useful to keep track of their symptoms. Keeping a log of symptoms can help better understand them, identify which symptoms impact them most, and identify patterns and changes in their symptoms. (99) Due to the wide-ranging and multi-organ nature of symptoms, the treatment and rehabilitation options must vary for people with long COVID.

Internationally, multidisciplinary teams are working together to tackle the unique symptoms each patient experiences and tailoring treatment to them. (3) Countries are creating dedicated treatment guidelines and care pathways, and the US, UK and Germany have opened post-COVID clinics as one-stop-shops for treatment and support. For example, an Adult Post-Acute COVID clinic at Vanderbilt University brings together specialists from internal medicine, infectious disease, pulmonology, cardiology, ophthalmology, psychology, physical medicine, ear, nose and throat, speech pathology and neurology. (3) Physical therapy, physiotherapy, and occupational therapy have also been key tools used for those struggling with fatigue. Nutritional support has also been important, with lethargy having flow-on effects onto the ability to cook and prepare food, resulting in some struggling with malnutrition. (100) Having sufficient time for the clinic visit is another part of current international clinic models for long COVID clinics, with one study endorsing initial visits of longer than 30 minutes and having the ability for follow-up as components of the services. (101)

Specific symptom management will usually be pragmatic, with avoidance of over-investigation. (98, 102)

Currently, there are no collated Aotearoa New Zealand resources for symptom management. The National Institute for Health Innovation has a page on long COVID (link) which directs patients and health professionals to the NHS (National Health Service, UK) COVID recovery website (below) and has symptom-based suggestions to manage long COVID at home.

The NHS, UK based, self-help site Your COVID Recovery has a page explaining long COVID. https://www.yourcovidrecovery.nhs.uk/what-is-covid-19/long-covid/. On this site there are patient resources to help manage many of the commonly experienced symptoms of long COVID including:

- Managing the effects on your body https://www.yourcovidrecovery.nhs.uk/managing-the-effects/effects-on-your-body/
- Managing the effects on your mind https://www.yourcovidrecovery.nhs.uk/managing-the-effects/effects-on-your-mind/
- Your wellbeing https://www.yourcovidrecovery.nhs.uk/your-wellbeing/

Te Whatu Ora – Waitemātā have developed Aotearoa New Zealand contextualised patient resources which includes guidance on what long COVID is. It shares tips and tricks for managing long COVID and looking after yourself, ensuring people with long COVID tend to not only their physical health but all aspects of Te Whare Tapa Whā, including advice for self-care, eating well, relaxation. Specific guidance on coping with

brain fog or cognitive changes is included, as well as guidance on managing fatigue and pacing, headaches, and keeping track of symptoms. (link)

Swiss based Altea Long COVID Network is an online site which focuses on the exchange of information about long COVID. Altea is a meeting place for those affected, relatives, medical professionals, researchers, and other interested parties. (link)

For children, specific resources are available from Long COVID Kids including:

- A support pack (link)
- Cautious Tortoise - a resource for to support decision making for a cautious approach to conditions triggered by a virus (link)
- Pacing Penguins, a resource on energy management (link)

For Aotearoa New Zealand, an equity focus with a co-design approach with key affected communities of those living with long COVID, Māori and Pacific peoples is key. Research was undertaken with an underserved community in the UK which discussed preferences of individuals in relation to their support for self-managed recovery from long COVID. (103) Patient and peer support networks have played a key role in the initial response to long COVID predominantly on social media platforms Facebook and Twitter.

Complementary medicine studies have also been undertaken to understand the role they may have in long COVID management. Fatigue is the most common long-haul symptom among women who have recovered from an acute COVID-19 infection. One randomised, blinded, controlled clinical trial evaluated an essential oil blend for energy boosting effects. Two weeks of twice-daily inhalation resulted in significant improvements to energy levels as compared to a placebo group. Aromatherapy improves energy levels among women who have recovered from COVID-19 but still experience low energy.(104) There is also evidence that Traditional Chinese Medicine (TCM) medications are effective in the symptom management of COVID-19 patients.(105) There are clinical trials underway exploring safety and efficacy of Ayurvedic interventions and yoga on the long term effects of COVID-19 (106), and osteopathy treatment for fatigue, however the results are not yet reported. (107) Conversely, evidence for the effectiveness of most Complementary and Alternative Medicine interventions still needs evaluation.

Rongoā Māori (Māori medicine) where ailments are treated in a holistic manner is also of cultural significance for Aotearoa populations. A scoping review is underway to examining the barriers and facilitators for Māori accessing injury and rehabilitation services, and the findings will be of benefit when considering long COVID rehabilitation for the priority populations affected by long COVID. (108)

Evaluations of services

A scoping review (109) aimed to identify key concepts and knowledge gaps foong COVID by conducting a review of literature on the condition's management by United Kingdom GPs. Six key themes were identitied which impact on the delivery of services: (1) GP uncertainty, (2) listening and empathy, (3) assessment and monitoring of symptoms, (4) coordinating access to appropriate services, (5) facilitating provision of continual and integrated multidisciplinary care and (6) the need to provide or facilitate psychological support. The findings show that GPs can play and have played a key role in the management of long COVID, and that patient care can be improved through better understanding of patient experiences, standardised approaches for symptom identification and treatment, and facilitation of access to multidisciplinary

specialist services when needed, however GPs need to be well resourced and upskilled to provide clear support.

There are several case reports endorsing supervised exercise and education programmes. The studies advocate for multidisciplinary rehabilitation to reduce disability and improve functionality (110) and quality of life (111); improvements in six-minute walk test, dyspnoea scores (112) and anxiety scales; (113, 114). However, it is noted, some of the studies have been completed on patients prior to 2022 and the widespread Omicron outbreak or on hospitalised patients which does not reflect all patients presenting with long COVID in Aotearoa New Zealand.

The use of virtual rehabilitation (115), telemonitoring (116) and mobile healthcare for rural areas (117) were all identified in the literature as service models for delivery of care in long COVID patients. High patient satisfaction (60, 117) was one of the outcomes from studies utilising these service models.

Olfactory training has also been studied for the treatment of persistent olfactory disorders however the outcomes of the study were not conclusive as beneficial. (118)

International guidelines on rehabilitation and management

Existing international guidelines propose that the initial management of long COVID should be in primary care and should include a series of investigations both to characterise how the individual is affected and to exclude other conditions that may coexist. Management, referrals and care pathways should then be tailored to the manifestations of disease, including investigation and referral for signs of involvement of different organ systems. (5, 119) The patient voice has been critical in shaping awareness of long COVID internationally and within New Zealand, and patient- and whānau-centred care should continue to be the focus.

Alongside treatment options, support and care services may be needed for people with persistent symptoms. Counselling and psychological support may be needed to address high rates of poor mental health, and many of the post-COVID clinics set up throughout the US and UK contain psychology services or referrals. (122) Psychological supports can also help people with the process of recovery and not just the psychological adjustment. Timely access to good quality information to understand their illness, managing expectations of others, as well as positive contact with people who are or previously been through this illness also assist in an individual's recovery. (123)

There are an increasing number of guidelines available for clinical management of patients with long COVID. Some of these are listed below.

Source	Title	Date	Link	Notes
Australian National COVID-19 Clinical Evidence	Australian Guidelines for the clinical care of people with COVID-19: Post COVID-19	Living Guidelines last updated 9 May 2022	https://app.magicapp.org/#/guideline/L4Q5An/section/jDJJJQ	Guidance for clinicians on: - Assessing and diagnosing post-COVID conditions - A consensus recommendation of symptoms and signs - Management and care of people with post-COVID-19 condition

National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN) and Royal College of General Practitioners (RCGP)	COVID-19 rapid guideline: managing the long-term effects of COVID-19	Version 1.14 published on 01.03.2022	https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-5103551574 2	Guidance for clinicians on: - Identification - Assessment - Investigations and referral - Planning care - Management (including self-management or supported management, multidisciplinary rehabilitation, and additional support) - Follow-up, monitoring, and discharge - Sharing information and continuity of care - Service organisation - Common symptoms - Equality considerations
Centres for Disease Control and Prevention (CDC), USA	Interim Guidance on Evaluating and Caring for Patients with Post-COVID Conditions	June 2021	https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-index.html	Includes guidance on general clinical considerations, patient history and physical examinations, assessment, and testing, management, and public health recommendations. The guidelines argue many post-COVID conditions can be managed by primary care providers, with the incorporation of patient-centred approaches to optimise the quality of life and function in affected patients. Objective laboratory or imaging findings should not be used as the only measure or assessment of a patient's well-being; lack of laboratory or imaging abnormalities does not invalidate the existence, severity, or importance of a patient's symptoms or conditions. Healthcare professionals and patients are encouraged to set achievable goals through shared decision-making and to approach treatment by focusing on specific symptoms (e.g., headache) or conditions (e.g., dysautonomia); a comprehensive management plan focusing on improving physical, mental, and social wellbeing may be helpful for some patients.
BMJ Practice Pointer (102)BMJ Practice Pointer (102)	Management of post-acute COVID-19 in primary care	Aug 2020	https://www.bmj.com/content/370/bmj.m3026	Guidance for the management of people with long COVID in primary care.
Royal Australian	Caring for Patients	May 2022	https://www.racgp.org.a	The purpose of this resource is to provide advice and support to GPs and their teams when caring for patients

College of General Practitioners	with Post COVID-19 Syndrome		u/getattachment/8c5b3936-5551-4b94-81d4-614e2b69da51/Caring-for-patients-with-post-COVID-19-conditions.aspx	with post–COVID-19 conditions, and to encourage the development of individualised plans for their ongoing management.
Scottish Intercollegiate Guidelines Network (SIGN) (124)Scottish Intercollegiate Guidelines Network (SIGN) (124)	Managing the long-term effects of COVID-19	Dec 2020	https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf	This document covers care for people who have symptoms that develop during or after an infection consistent with COVID-19, continue for more than four weeks and are not explained by an alternative diagnosis. It also provides advice on diagnosis and management based both on the best available evidence and the knowledge and experience of the expert panel.
Ontario Health	Post-COVID-19 Condition: Guidance for Primary Care	Dec 2021	https://www.ontariohealth.ca/sites/ontariohealth/files/2021-12/PostCovidConditionsClinicalGuidance_EN.pdf	This document includes guidance for primary care on: - Assessment - Testing - Diagnosis - Physical examination - Management
Chartered Society of Physiotherapy	COVID-19 Rehabilitation Standards	August 2021	https://www.csp.org.uk/publications/covid-19-community-rehabilitation-physiotherapy-service-delivery	UK guidance for physiotherapy service delivery for adults who are hospitalised due to acute COVID-19 or long COVID

Policy Responses

The full magnitude of the long COVID burden globally is still yet to be known, with countries all at varying stages of their response to COVID-19, with some only having experienced significant outbreaks following the emergence of the Omicron variant, resulting in a lack of first-hand experience in addressing long COVID and undeveloped systems to respond to and report on long COVID.

For an equitable policy response in Aotearoa New Zealand, partnership, and shared decision-making with key affected communities, including those with long COVID, the Māori Health Authority, the Ministry for Pacific Peoples, and the New Ministry for Disabled People.

United Kingdom: The UK government has set up over 80 specialist clinics[i] to provide support to those suffering from long COVID, which provide psychological and physiological support services. Further research funding is being provided through grants to NGOs and healthcare providers through the National institute of health, to date only around 50 million pounds of funding has been provided for research in to Long COVID. The UK government has made Statutory Sick Payments, Universal Credit or Employment and Support Allowance (ESA) available to people if Long COVID affects how much they can work. Affected individuals can also apply for a Personal Independence Payment if they have difficulty with everyday tasks and getting around.[ii] The UK's response has endeavoured to provide all information in accessible and age-appropriate formats so that people can understand and take part in decisions about their care, as guided by the NICE guidelines on shared decision making and good patient experiences.

United States: As of July 2021, long COVID, also known as post-COVID conditions, can be considered a disability under the Americans with Disabilities Act President Joe Biden has directed federal agencies to support patients and doctors by providing science-based best practices for treating long COVID, maintaining access to insurance coverage, and protecting the rights of workers as they try to return to jobs while coping with the uncertainties of the malaise.

France: Since the French government identified Long COVID at the end of the first wave of the virus in spring 2020, it has been watching the issue closely to care for those affected and to better understand the disease. On 17 March 2022, the Health Minister published a statement recognising Long COVID as a health concern in France and acknowledging the necessity for ongoing research into its prevalence, diagnosis, and treatment.

Germany: The German Government has committed to the establishment of a Germany-wide network of 2,580 competence centres and interdisciplinary outpatient clinics to further research and ensure needs-based care around the long-term effects of COVID-19. German physicians dealing with Long COVID have established a dedicated national association, with thirteen specialised working groups, to promote research, share information and improve the treatment of patients suffering from Long COVID.

Sweden: The Swedish government has implemented several responses to Long COVID. It has supported research on COVID-19 through funding to the Swedish Research Council and tasked the Swedish Agency for Health and Care Services Analysis with mapping Long COVID care across the country. The National Board of Health and Welfare has produced guidelines and statistical reports to support the health and welfare system in meeting the needs of Long COVID sufferers. However, the general lack of information about the condition, and awareness of it, as well as the immense pressure on the healthcare system during the pandemic, means that a system for testing and assessment, treatment, and support available to sufferers is not yet fully functioning.

Next Steps	Share with CAHPO

In the development of this work, the following parties have been consulted with:	CAHPO EAG STA

Resources used:		
Ministry of Health Policies and Procedures	☒ Yes ☐ No	
External Health Scientific organisations	☐ Yes☐ No	
Existing database of RFAs	☒ Yes ☐ No	
Internal Ministry of Health Advice	☒ Yes ☐ No	
External Expert Advice	☐ Yes ☐ No	
Literature Review	☒ Yes ☐ No	

1. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188] 2021 [updated 11 November 2021. Available from: https://www.nice.org.uk/guidance/ng188.
2. Leung TYM, Chan AYL, Chan EW, Chan VKY, Chui CSL, Cowling BJ, et al. Short- and potential long-term adverse health outcomes of COVID-19: a rapid review. Emerg Microbes Infect. 2020;9(1):2190-9.
3. National Institute for Health Research. Living with COVID19 2020 [updated 15 October 2020. Available from: https://evidence.nihr.ac.uk/themedreview/living-with-covid19/#Conclusions

4. The Royal Society. Long Covid: what is it, and what is needed? 2020 [updated 23 October 2020. Available from: https://royalsociety.org/-/media/policy/projects/set-c/set-c-long-covid.pdf
5. World Health Organization (WHO). Policy Brief 39: In the wake of the pandemic - Preparing for Long COVID Copenhagen, Denmark: WHO,; 2021 [Available from: https://apps.who.int/iris/bitstream/handle/10665/339629/Policy-brief-39-1997-8073-eng.pdf.
6. Angamuthu N, Geraldine Gagasa E, Baker D, Tsui J, Evan D'Souza R. Transmission of infection among health care personnel performing surgical tracheostomies on COVID-19 patients. The surgeon : journal of the Royal Colleges of Surgeons of Edinburgh and Ireland. 2021.
7. Stephenson T, Allin B, Nugawela MD, Rojas N, Dalrymple E, Pinto Pereira S, et al. Long COVID (post-COVID-19 condition) in children: a modified Delphi process. Archives of Disease in Childhood. 2022;107(7):674-80.
8. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, et al. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. Scientific Reports. 2021;11(1):16144.
9. Hayes LD, Ingram J, Sculthorpe NF. More Than 100 Persistent Symptoms of SARS-CoV-2 (Long COVID): A Scoping Review. Frontiers in Medicine. 2021;8.
10. Cau R, Faa G, Nardi V, Balestrieri A, Puig J, Suri JS, et al. Long-COVID diagnosis: From diagnostic to advanced AI-driven models. European Journal of Radiology. 2022;148:110164.
11. COVID Symptom Study. Long COVID: What do we know so far? 2021 [updated 12 April 2021. Available from: https://covid.joinzoe.com/post/long-covid-what-we-know.
12. Bull-Otterson L BS, Saydah S, et al. . Post–COVID Conditions Among Adult COVID-19 Survivors Aged 18–64 and ≥65 Years — United States, March 2020–November 2021. MMWR Morb Mortal Wkly Rep. 2022;71:723-17.
13. Nasserie T, Hittle M, Goodman SN. Assessment of the Frequency and Variety of Persistent Symptoms Among Patients With COVID-19: A Systematic Review. JAMA Network Open. 2021;4(5):e2111417-e.
14. Fernández-Castañeda A, Lu, P., et al. Mild respiratory COVID can cause multi-lineage neural cell and myelin dysregulation. Cell. 2022.
15. Multisystem involvement is common in post-COVID-19 syndrome. Nature Medicine. 2022;28(6):1139-40.
16. Michelen M, Manoharan L, Elkheir N, Cheng V, Dagens A, Hastie C, et al. Characterising long COVID: a living systematic review. BMJ Global Health. 2021;6(9):e005427.
17. Groff D, Sun A, Ssentongo AE, Ba DM, Parsons N, Poudel GR, et al. Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review. JAMA Network Open. 2021;4(10):e2128568-e.
18. Antonelli MP, J.C., et al. Risk of long COVID associated with delta versus omicron variants of SARS-CoV-2. The Lancet. 2022;399(10343):2263-4.
19. Reynolds CJ, Pade C, Gibbons JM, Otter AD, Lin K-M, Muñoz Sandoval D, et al. Immune boosting by B. 1.1. 529 (Omicron) depends on previous SARS-CoV-2 exposure. Science. 2022;377(6603):eabq1841.
20. Pagel C. The covid waves continue to come. British Medical Journal Publishing Group; 2022.
21. Murdoch Children's Research Institute (MCRI). Research Brief: COVID-19 and Child and Adolescent Health Victoria, Australia: MCRI,; 2021 [updated 13 September 2021. Version 1:[Available from: https://www.mcri.edu.au/sites/default/files/media/documents/covid-19-and-child-and-adolescent-health-140921.pdf.
22. Zimmermann P, Pittet LF, Curtis N. How Common is Long COVID in Children and Adolescents? The Pediatric Infectious Disease Journal. 2021;40(12).
23. Radtke T, Ulyte A, Puhan MA, Kriemler S. Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents. JAMA. 2021;326(9):869-71.
24. Munblit D, Sigfrid L, Warner JO. Setting Priorities to Address Research Gaps in Long-term COVID-19 Outcomes in Children. JAMA Pediatrics. 2021;175(11):1095-6.

25. Molteni E, Sudre CH, Canas LS, Bhopal SS, Hughes RC, Antonelli M, et al. Illness duration and symptom profile in symptomatic UK school-aged children tested for SARS-CoV-2. The Lancet Child & Adolescent Health. 2021:708-18.
26. Sigfrid L, Drake TM, Pauley E, Jesudason EC, Olliaro P, Lim WS, et al. Long Covid in adults discharged from UK hospitals after Covid-19: A prospective, multicentre cohort study using the ISARIC WHO Clinical Characterisation Protocol 2021 [2021.03.18.21253888]. Available from: http://medrxiv.org/content/early/2021/03/23/2021.03.18.21253888.abstract.
27. Say D, Crawford N, McNab S, Wurzel D, Steer A, Tosif S. Post-acute COVID-19 outcomes in children with mild and asymptomatic disease. The Lancet Child & Adolescent Health. 2021;5(6):e22-e3.
28. Zimmermann P, Pittet LF, Curtis N. The Challenge of Studying Long COVID: An Updated Review. The Pediatric infectious disease journal. 2022;41(5):424-6.
29. Roessler M, Tesch F, Batram M, Jacob J, Loser F, Weidinger O, et al. Post COVID-19 in children, adolescents, and adults: results of a matched cohort study including more than 150,000 individuals with COVID-19 2021 [2021.10.21.21265133]. Available from: http://medrxiv.org/content/early/2021/10/22/2021.10.21.21265133.abstract.
30. Office for National Statistics UK. Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK 2021 [Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/alldatarelatingtoprevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk.
31. Lewis D. Long COVID and kids: scientists race to find answers: Nature; 2021 [updated 18 November 2021. Available from: https://www.nature.com/articles/d41586-021-01935-7?utm_source=twt_nat&utm_medium=social&utm_campaign=nature.
32. Buonsenso D, Munblit D, De Rose C, Sinatti D, Ricchiuto A, Carfi A, et al. Preliminary evidence on long COVID in children. Acta Paediatrica. 2021.
33. KiKKenborg Berg S, Palm, P. et al. Long COVID symptoms in SARS-CoV-2-positive children aged 0–14 years and matched controls in Denmark (LongCOVIDKidsDK): a national, cross-sectional study. The Lancet Child & Adolescent Health. 2022.
34. Stephenson T, Pinto Pereira SM, Shafran R, de Stavola BL, Rojas N, McOwat K, et al. Physical and mental health 3 months after SARS-CoV-2 infection (long COVID) among adolescents in England (CLoCk): a national matched cohort study. The Lancet Child & Adolescent Health. 2022.
35. Morrow AKMN, Rowena PhD; Vargas, Gray PhD; Jashar, Dasal Tenzin PhD; Henning, Ellen PhD; Stinson, Nika PT, DPT; Malone, Laura A. MD, PhD. . Postacute/Long COVID in Pediatrics: Development of a Multidisciplinary Rehabilitation Clinic and Preliminary Case Series. American Journal of Physical Medicine & Rehabilitation: December 2021. 2022;100:1140-7.
36. Jason LA, Katz BZ, Shiraishi Y, Mears CJ, Im Y, Taylor R. Predictors of Post-Infectious Chronic Fatigue Syndrome in Adolescents. Health Psychol Behav Med. 2014;2(1):41-51.
37. Katz BZ, Shiraishi Y, Mears CJ, Binns HJ, Taylor R. Chronic fatigue syndrome after infectious mononucleosis in adolescents. Pediatrics. 2009;124(1):189-93.
38. Funk AL, Kuppermann N, Florin TA, Tancredi DJ, Xie J, Kim K, et al. Post–COVID-19 Conditions Among Children 90 Days After SARS-CoV-2 Infection. JAMA Network Open. 2022;5(7):e2223253-e.
39. Martin C, Luteijn M, Letton W, Robertson J, McDonald S. A model framework for projecting the prevalence and impact of Long-COVID in the UK. PloS one. 2021;16(12):e0260843-e.
40. Ministry of Health NZ. Long COVID 2021 [updated 21 June 2021. Available from: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-health-advice-public/about-covid-19/long-covid.
41. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing Long COVID in an International Cohort: 7 Months of Symptoms and Their Impact 2021 [2020.12.24.20248802]. Available from: http://medrxiv.org/content/early/2021/04/05/2020.12.24.20248802.abstract.
42. Chen C, Haupert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global Prevalence of Post COVID-19 Condition or Long COVID: A Meta-Analysis and Systematic Review. The Journal of Infectious Diseases. 2022.

43. Taquet M, Dercon Q, Luciano S, Geddes JR, Husain M, Harrison PJ. Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. PLOS Medicine. 2021;18(9):e1003773.
44. Zeng N, Zhao Y-M, Yan W, Li C, Lu Q-D, Liu L, et al. A systematic review and meta-analysis of long term physical and mental sequelae of COVID-19 pandemic: call for research priority and action. Molecular Psychiatry. 2022.
45. Wulf Hanson S, Abbafati C, Aerts JG, Al-Aly Z, Ashbaugh C, Ballouz T, et al. A global systematic analysis of the occurrence, severity, and recovery pattern of long COVID in 2020 and 2021 2022 [2022.05.26.22275532]. Available from: http://medrxiv.org/content/early/2022/05/27/2022.05.26.22275532.abstract.
46. Brooks A. Immunity and Pathology. Long COVID: Journeying together through the fog (webinar): University of Otago, Wellington; 2022.
47. Hurst M. Long COVID (webinar). Goodfellow Unit; 2022.
48. Zollner A, Koch R, Jukic A, Pfister A, Meyer M, Rössler A, et al. Postacute COVID-19 is Characterized by Gut Viral Antigen Persistence in Inflammatory Bowel Diseases. Gastroenterology.163(2):495-506.e8.
49. Denise Goh JCTL, Sonia Bilbao Fernández et al. . Persistence of residual SARS-CoV-2 viral antigen and RNA in tissues of patients with long COVID-19, PREPRINT. Research square. 2022.
50. Mobasheri L, Nasirpour MH, Masoumi E, Azarnaminy AF, Jafari M, Esmaeili SA. SARS-CoV-2 triggering autoimmune diseases. Cytokine. 2022;154:155873.
51. Giannos P, Prokopidis K. Gut dysbiosis and long COVID-19: Feeling gutted. . J Med Virol. 2022;94(7):2917-8.
52. Frere JJ, Serafini RA, Pryce KD, Zazhytska M, Oishi K, Golynker I, et al. SARS-CoV-2 infection in hamsters and humans results in lasting and unique systemic perturbations post recovery. Science Translational Medicine.0(0):eabq3059.
53. Pustake M, Tambolkar I, Giri P, Gandhi C. SARS, MERS and CoVID-19: An overview and comparison of clinical, laboratory and radiological features. Journal of Family Medicine and Primary Care. 2022;11(1):10-7.
54. Newman M. Chronic fatigue syndrome and long covid: moving beyond the controversy. BMJ. 2021;373:n1559.
55. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Long COVID burden and risk factors in 10 UK longitudinal studies and electronic health records. Nat Commun. 2022;13(1):3528.
56. Centers for Disease Control and Prevention (CDC). Post-COVID Conditions: Overview 2021 [updated 9 July 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Fclinical-care%2Flate-sequelae.html.
57. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Risk factors for long COVID: analyses of 10 longitudinal studies and electronic health records in the UK. medRxiv. 2021:2021.06.24.21259277.
58. Stewart S, Newson L, Briggs TA, Grammatopoulos D, Young L, Gill P. Long COVID risk - a signal to address sex hormones and women's health. The Lancet Regional Health – Europe. 2021;11.
59. Sylvester SV, Rusu R, Chan B, Bellows M, O'Keefe C, Nicholson S. Sex differences in sequelae from COVID-19 infection and in long COVID syndrome: a review. Current Medical Research and Opinion. 2022:1-9.
60. Al-Aly Z, Bowe B, Xie Y. Long COVID after breakthrough SARS-CoV-2 infection. Nature Medicine. 2022;28(7):1461-7.
61. Cervia C, Zurbuchen Y, Taeschler P, Ballouz T, Menges D, Hasler S, et al. Immunoglobulin signature predicts risk of post-acute COVID-19 syndrome. Nat Commun. 2022;13(1):446.
62. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, et al. Attributes and predictors of long COVID. Nature Medicine. 2021;27(4):626-31.

63. Su Y, Yuan D, Chen DG, Ng RH, Wang K, Choi J, et al. Multiple early factors anticipate post-acute COVID-19 sequelae. Cell. 2022;185(5):881-95.e20.
64. Liu Q, Mak JWY, Su Q, Yeoh YK, Lui GC-Y, Ng SSS, et al. Gut microbiota dynamics in a prospective cohort of patients with post-acute COVID-19 syndrome. Gut. 2022;71(3):544.
65. Antonelli M, Penfold RS, Merino J, Sudre CH, Molteni E, Berry S, et al. Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study. The Lancet Infectious Diseases. 2022;22(1):43-55.
66. Gold JE, Okyay RA, Licht WE, Hurley DJ. Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation. Pathogens. 2021;10(6):763.
67. Ayoubkhani D, Bermingham C, Pouwels KB, Glickman M, Nafilyan V, Zaccardi F, et al. Trajectory of long covid symptoms after covid-19 vaccination: community based cohort study. BMJ. 2022;377:e069676.
68. Sivan M, Greenhalgh T, Milne R, Delaney B. Are vaccines a potential treatment for long covid? BMJ. 2022;377:o988.
69. UK Health Security Agency. The effectiveness of vaccination against long COVID. A rapid evidence briefing 2022 [Available from: https://ukhsa.koha-ptfs.co.uk/cgi-bin/koha/opac-retrieve-file.pl?id=fe4f10cd3cd509fe045ad4f72ae0dfff.
70. UKHSA review shows vaccinated less likely to have long COVID than unvaccinated [press release]. UK Government, 15 Feb 2022 2022.
71. Mahase E. Covid-19: Vaccinated people are less likely to get long covid, review finds. BMJ. 2022;376:o407.
72. Arnold DT, Milne A, Samms E, Stadon L, Maskell NA, Hamilton FW. Are vaccines safe in patients with Long COVID? A prospective observational study 2021 [2021.03.11.21253225]. Available from: http://medrxiv.org/content/early/2021/03/14/2021.03.11.21253225.1.abstract.
73. Mahase E. Covid-19: Do vaccines work against omicron-and other questions answered. BMJ (Clinical research ed). 2021;375:n3062.
74. Mumtaz A, Sheikh AAE, Khan AM, Khalid SN, Khan J, Nasrullah A, et al. COVID-19 Vaccine and Long COVID: A Scoping Review. Life. 2022;12(7):1066.
75. Strain WD, Sherwood O, Banerjee A, Van der Togt V, Hishmeh L, Rossman J. The Impact of COVID Vaccination on Symptoms of Long COVID: An International Survey of People with Lived Experience of Long COVID. Vaccines (Basel). 2022;10(5).
76. Simon MA, Luginbuhl RD, Parker R. Reduced Incidence of Long-COVID Symptoms Related to Administration of COVID-19 Vaccines Both Before COVID-19 Diagnosis and Up to 12 Weeks After. medRxiv. 2021:2021.11.17.21263608.
77. Taquet M, Dercon Q, Harrison PJ. Six-month sequelae of post-vaccination SARS-CoV-2 infection: a retrospective cohort study of 10,024 breakthrough infections. medRxiv. 2021:2021.10.26.21265508.
78. Blumberg Y, Edelstein M, Jabal KA, Golan R, Perets Y, Saad M, et al. Protective effect of BNT162b2 vaccination on aerobic capacity following mild to moderate SARS-CoV-2 infection: a cross sectional study, Israel, March-December 2021. medRxiv. 2022:2021.12.30.21268538.
79. Azzolini E, Levi R, Sarti R, Pozzi C, Mollura M, Mantovani A, et al. Association Between BNT162b2 Vaccination and Long COVID After Infections Not Requiring Hospitalization in Health Care Workers. JAMA Published online July 01. 2022.
80. Tsuchida T, Hirose M, Inoue Y, Kunishima H, Otsubo T, Matsuda T. Relationship between changes in symptoms and antibody titers after a single vaccination in patients with Long COVID. Journal of Medical Virology. 2022;94(7):3416-20.
81. Reardon S. Long COVID risk falls only slightly after vaccination, huge study shows: Nature News; 2022 [updated 25 May 2022. Available from: https://www.nature.com/articles/d41586-022-01453-0.
82. Strain WD, Sherwood O, Banerjee A, Van der Togt V, Hishmeh L, Rossman J. The Impact of COVID Vaccination on Symptoms of Long COVID: An International Survey of People with Lived Experience of Long COVID. Vaccines. 2022;10(5):652.

83. Tran V-TaP, Elodie and Saldanha, Julia and Pane, Isabelle and Ravaud, Philippe,. Efficacy of COVID-19 Vaccination on the Symptoms of Patients With Long COVID: A Target Trial Emulation Using Data From the ComPaRe e-Cohort in France. Pre-print. The Lancet. 2021.
84. Arjun MC, Singh AK, Pal D, Das K, Gajjala A, Venkateshan M, et al. Prevalence, characteristics, and predictors of Long COVID among diagnosed cases of COVID-19. medRxiv; 2022.
85. Gaber TA, A. Unsworth, A. Martindale, J. Are mRNA Covid 19 vaccines safe in Long Covid patients? A Health Care Workers

perspective. British Journal of Medical Practitioners,. 2021;14(1).
86. Kuodi P, Gorelik Y, Zayyad H, Wertheim O, Wiegler KB, Jabal KA, et al. Association between vaccination status and reported incidence of post-acute COVID-19 symptoms in Israel: a cross-sectional study of patients tested between March 2020 and November 2021. medRxiv. 2022:2022.01.05.22268800.
87. Nehme M, Braillard O, Salamun J, Jacquerioz F, Courvoisier DS, Spechbach H, et al. Symptoms After COVID-19 Vaccination in Patients with Post-Acute Sequelae of SARS-CoV-2. Journal of General Internal Medicine. 2022;37(6):1585-8.
88. Peghin M, De Martino M, Palese A, Gerussi V, Bontempo G, Graziano E, et al. Post–COVID-19 syndrome and humoral response association after 1 year in vaccinated and unvaccinated patients. Clinical Microbiology and Infection. 2022;28(8):1140-8.
89. Scherlinger M, Pijnenburg L, Chatelus E, Arnaud L, Gottenberg J-E, Sibilia J, et al. Effect of SARS-CoV-2 Vaccination on Symptoms from Post-Acute Sequelae of COVID-19: Results from the Nationwide VAXILONG Study. Vaccines. 2022;10(1):46.
90. Senjam SS, Balhara YPS, Kumar P, Nichal N, Manna S, Madan K, et al. Assessment of Post COVID-19 Health Problems and its Determinants in North India: A descriptive cross section study. medRxiv. 2021:2021.10.03.21264490.
91. Wisnivesky JP, Govindarajulu U, Bagiella E, Goswami R, Kale M, Campbell KN, et al. Association of Vaccination with the Persistence of Post-COVID Symptoms. J Gen Intern Med. 2022;37(7):1748-53.
92. Couzin-Frankel JV, G. In rare cases, coronavirus vaccines may cause Long Covid–like symptoms. In: Health SI, editor. Science2022.
93. Barthélémy H, Mougenot E, Duracinsky M, Salmon-Ceron D, Bonini J, Péretz F, et al. Smoking increases the risk of post-acute COVID-19 syndrome: Results from a French community-based survey. Tob Induc Dis. 2022;20:59.
94. Hall M. Is Long Covid a new type of chronic fatigue syndrome? RNZ2021 [Available from: https://www.rnz.co.nz/news/what-you-need-to-know/456714/is-long-covid-a-new-type-of-chronic-fatigue-syndrome.
95. Faghy MA, Maden-Wilkinson T, Arena R, Copeland RJ, Owen R, Hodgkins H, et al. COVID-19 patients require multi-disciplinary rehabilitation approaches to address persisting symptom profiles and restore pre-COVID quality of life. Expert Review of Respiratory Medicine. 2022:1-6.
96. Hussain FA. Facilitating care: a biopsychosocial perspective on long COVID. British Journal of General Practice. 2022;72(714):30-1.
97. Maltezou HC, Pavli A, Tsakris A. Post-COVID Syndrome: An Insight on Its Pathogenesis. Vaccines (Basel). 2021;9(5).
98. RACGP. Caring for adult patients with post-COVID-19 conditions East Melbourne, VIC2020 [
99. The National Institute for Health Innovation. Long COVID 2021 [Available from: https://www.nihi.auckland.ac.nz/long-covid.
100. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, et al. Post-acute COVID-19 syndrome. Nature Medicine. 2021;27(4):601-15.
101. Dundumalla S, Barshikar, S, Niehaus, WN, Ambrose, AF, Kim, SY, Abramoff, BA. . A survey of dedicated PASC clinics: Characteristics, barriers and spirit of collaboration. PM&R. 2022;14:348- 56.
102. Greenhalgh T, Knight M, A'Court C, Buxton M, Husain L. Management of post-acute covid-19 in primary care. BMJ. 2020;370:m3026.

103. Fowler-Davis S, Young R, Maden-Wilkinson T, Hameed W, Dracas E, Hurrell E, et al. Assessing the Acceptability of a Co-Produced Long COVID Intervention in an Underserved Community in the UK. International Journal of Environmental Research and Public Health. 2021;18(24):13191.
104. Hawkins J, Hires C, Keenan L, Dunne E. Aromatherapy blend of thyme, orange, clove bud, and frankincense boosts energy levels in post-COVID-19 female patients: A randomized, double-blinded, placebo controlled clinical trial. Complementary Therapies in Medicine. 2022;67:102823.
105. Jeon S-R, Kang JW, Ang L, Lee HW, Lee MS, Kim T-H. Complementary and alternative medicine (CAM) interventions for COVID-19: An overview of systematic reviews. Integrative Medicine Research. 2022;11(3):100842.
106. Yadav B, Rai A, Mundada PS, Singhal R, Rao BCS, Rana R, et al. Safety and efficacy of Ayurvedic interventions and Yoga on long term effects of COVID-19: A structured summary of a study protocol for a randomized controlled trial. Trials. 2021;22(1):378.
107. Curi ACC, Ferreira APA, Nogueira LAC, Meziat Filho NAM, Ferreira AS. Osteopathy and physiotherapy compared to physiotherapy alone on fatigue in long COVID: Study protocol for a pragmatic randomized controlled superiority trial. International Journal of Osteopathic Medicine. 2022.
108. Nelson V LM, Richard L, et al. Examining the barriers and facilitators for Māori accessing injury and rehabilitation services: a scoping review protocol. BMJ open. 2022;12(2):e048252.
109. Brennan A, Broughan J, McCombe G, Brennan J, Collins C, Fawsitt R, et al. Enhancing the management of long COVID in general practice: a scoping review. BJGP Open. 2022:BJGPO.2021.0178.
110. Güler T, Yurdakul FG, Acar Sivas F, Kiliç Z, Adigüzel E, Yaşar E, et al. Rehabilitative management of post-acute COVID-19: clinical pictures and outcomes. Rheumatol Int. 2021;41(12):2167-75.
111. Nopp S, Moik F, Klok FA, Gattinger D, Petrovic M, Vonbank K, et al. Outpatient Pulmonary Rehabilitation in Patients with Long COVID Improves Exercise Capacity, Functional Status, Dyspnea, Fatigue, and Quality of Life. Respiration. 2022;101(6):593-601.
112. Soril LJJ, Damant RW, Lam GY, Smith MP, Weatherald J, Bourbeau J, et al. The effectiveness of pulmonary rehabilitation for Post-COVID symptoms: A rapid review of the literature. Respiratory Medicine. 2022;195:106782.
113. N Elliott AB, N Heron, C Ranson, J Hull , R Martin, J Elliott. British Journal of sports medicineApril 23, 2022. [cited 2022]. Available from: https://blogs.bmj.com/bjsm/2022/04/23/graduated-return-to-play-after-sars-cov-2-infection-what-have-we-learned-and-why-weve-updated-the-guidance/
114. Albu S, Rivas Zozaya N, Murillo N, García-Molina A, Figueroa Chacón CA, Kumru H. Multidisciplinary outpatient rehabilitation of physical and neurological sequelae and persistent symptoms of covid-19: A prospective, observational cohort study. Disability and Rehabilitation. 2021:1-8.
115. Harenwall S, Heywood-Everett S, Henderson R, Godsell S, Jordan S, Moore A, et al. Post-Covid-19 Syndrome: Improvements in Health-Related Quality of Life Following Psychology-Led Interdisciplinary Virtual Rehabilitation. Journal of Primary Care & Community Health. 2021;12:21501319211067674.
116. Romaszko-Wojtowicz A, Maksymowicz S, Jarynowski A, Jaśkiewicz Ł, Czekaj Ł, Doboszyńska A. Telemonitoring in Long-COVID Patients—Preliminary Findings. International journal of environmental research and public health. 2022;19(9):5268.
117. Stallmach A, Katzer K, Besteher B, Finke K, Giszas B, Gremme Y, et al. Mobile primary healthcare for post-COVID patients in rural areas: a proof-of-concept study. Infection. 2022.
118. Vandersteen C, Payne M, Dumas L, Cancian É, Plonka A, D'Andréa G, et al. Olfactory Training in Post-COVID-19 Persistent Olfactory Disorders: Value Normalization for Threshold but Not Identification. J Clin Med. 2022;11(12).
119. Manhas KP, O'Connell P, Krysa J, Henderson I, Ho C, Papathanassoglou E. Development of a Novel Care Rehabilitation Pathway for Post-COVID Conditions (Long COVID) in a Provincial Health System in Alberta, Canada. Physical Therapy. 2022.
120. Dahlgren G, Whitehead M. The Dahlgren-Whitehead model of health determinants: 30 years on and still chasing rainbows. Public Health. 2021;199:20-4.

121. Diderichsen F, Hallqvist J, Whitehead M. Differential vulnerability and susceptibility: how to make use of recent development in our understanding of mediation and interaction to tackle health inequalities. International Journal of Epidemiology. 2019;48(1):268-74.
122. Walter K. An Inside Look at a Post–COVID-19 Clinic. JAMA. 2021.
123. Skirrow P, Morris, L. Thoughts that Count [Presentation]. 2022 [Available from: https://az659834.vo.msecnd.net/eventsairaueprod/production-otago-public/bfb8d575b3b342c7b72be4c5fb221c0c.
124. Scottish Intercollegiate Guidelines Network. SIGN 161: Managing the long-term effects of COVID-19: National guidance for identification, assessment and management Edinburgh: SIGN; 2020 [updated 18 December 2020. Available from: https://www.sign.ac.uk/media/1833/sign161-long-term-effects-of-covid19-11.pdf.

[i] British Medical Journal – COVID-19 How Europe is approaching long COVID - https://www.bmj.com/content/376/bmj.o158 - Accessed 13 May 2022
[ii] UK Government - Find help and support if you have long COVID - https://www.gov.uk/guidance/find-help-and-support-if-you-have-long-covid#if-you-have-long-covid-and-are-unable-to-work – Accessed 13 May 2022