Guidance for the assessment of post-COVID-19 (long-COVID) condition in underwriting and claims handling

NOT IF, BUT HOW

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1 Abstract

As the COVID-19 pandemic continues, there is a need within the Life and Health Insurance business for the evaluation of potential long-term effects of COVID-19. The impact of the syndrome called post-COVID-19 condition or long-COVID with a constellation of physical, cognitive, and psychological symptoms on underwriting and claims handling is unknown but could be substantial. Therefore, it is fundamental to understand this syndrome and its symptoms and accurately assess them.

The purpose of this article is to provide an overview of the most relevant symptoms in post-COVID-19 condition and their structured assessment. It is intended to help in the classification and evidence-based evaluation of these symptoms. Our proposal could therefore serve as guidance for underwriting and claims handling for post-COVID-19 condition.

2 Introduction and definition of post-COVID-19 condition

More than two years after the first case of COVID-19 caused by the SARS-CoV-2 virus was reported, many aspects of COVID-19 remain unclear. An issue of concern – not only in insurance medicine – is a syndrome called "post-COVID-19 condition" due to its wide variety of symptoms, uncertain duration and possible impact on working capacity.

Although most individuals with acute COVID-19 recover within days or weeks of onset of illness, some persons experience a wide range of new, recurring, or ongoing symptoms and clinical findings lasting for weeks or even months. These long-term symptoms associated with previous acute COVID-19 have been referred to by a wide range of medical terms, including "long-COVID" and "Post-Acute Sequelae of SARS-CoV-2 infection" (PASC). Accordingly, an international consensus as how this syndrome is exactly defined was lacking until a definition was published by the World Health Organization in October 2021. The syndrome of long-term symptoms after acute COVID-19 is now termed post-COVID-19 condition. The definition is as follows:

"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."

This definition underlines that post-COVID-19 condition will a) almost certainly result in short and long-term disability claims due to its required impact on everyday functioning, and b) will pose a major challenge in underwriting (UW) and claims handling due to its fluctuating nature and only facultative evidence of definitive SARS-CoV-2 infection. Therefore, it is essential that insurers understand the definition, natural history, symptoms and appropriate assessment of post-COVID-19 condition. The purpose of this article is to provide assistance and guidance in understanding and assessing post-COVID-19 condition in UW and claims handling.

3 Key challenges in underwriting and claims handling

3.1 Current definition

The current WHO definition of post-COVID-19 condition has been developed to facilitate identification of affected patients and foster comparable research on this topic. Admittedly, this definition is broad and contains some uncertainties due to the lack of precise knowledge of this condition up to date. In contrast to confirmed SARS-CoV-2 infection, the inclusion of cases with probable SARS-CoV-2 infection is challenging from our perspective, as the pathologic pathway from acute infection to long-term sequelae should be coherent. In fact, SARS-CoV-2 specific antibodies can be detected by laboratory means and can distinguish between vaccine-induced response and natural infection. Furthermore, virtually every symptom could be related to post-COVID-19 condition according to this definition, and in addition, these symptoms may fluctuate or relapse over time.

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Evidently, underwriting and claims handling relies on concise medical definitions. A broad definition will inevitably require more interpretation of provided medical information. Nevertheless, the WHO acknowledges that alternative diagnosis must be considered. Whether these must be ruled out is debatable. Notwithstanding, the current definition of post-COVID-19 condition gives for the first time a temporal framework, leading to the conclusion that the diagnosis of post-COVID-19 condition can be made three months after acute infection (symptoms lasting for at least two months). The notion that the WHO has acknowledged a general impact of these symptoms on everyday functioning is particularly relevant for the insurance business. Whether this impact is documented in the majority of cases will be essential to guide decisions especially in claims handling.

3.2 Symptoms and capability to objectify

Persistent physical symptoms following acute COVID-19 can comprise fatigue, dyspnoea, reduced performance, and cough. Patients recovering from COVID-19 may also have additional psychological (e.g. anxiety, depression) and cognitive (e.g. poor memory and concentration) symptoms. Figure 1 provides an overview of symptoms and their frequency in post-COVID-19 condition, compiling data from several large studies from Europe, North America and China (Carfi A et al., Goertz YM et al, Halpin S et al, Huang C et al., Seeßle J et al., Wong AW et al.).

Figure 1: Symptoms of post-COVID-19 condition in order of frequency. (PTSD, post-traumatic stress disorder). Sources: Carfi A et al., Goertz YM et al, Halpin S et al, Huang C et al., Seeßle J et al., and Wong AW et al.

Very frequent	Frequent	Infrequent
– Fatigue – Dyspnoea (rest/stress) – Reduced performance – Cognitive dysfunction	– Loss of smell and taste – Cough – Headache – Sleep disturbance – Depressive moods – Anxiety – PTSD symptoms – General pain – Vertigo	– Paralysis and sensory disturbances – Dizziness – Nausea – Fever – Diarrhoea – Loss of appetite – Tinnitus – Earache – Palpitations – Tachykardia – Hair loss

Suffering from most of these symptoms does not automatically mean fulfilling the claim requirements based on the terms and conditions of a specific insurance product, especially regarding income protection products. From our perspective, it is crucial to identify symptoms and to answer the question whether these symptoms can be objectified.

To solve this question, it is essential that organ-specific symptoms can be assigned to the respective medical fields (e.g. loss of smell and taste). Each medical field provides its analytical methods and examinations that might contribute to objectify these symptoms. Still, some symptoms will remain un-objectifiable, despite all analytical efforts. We will provide more detailed information on symptoms and associated measurements and examinations in the following sections.

3.3 Management

To be able to assess post-COVID-19 condition in respect to underwriting and claims handling, the course and severity of symptoms and their impact on working capacity and functioning in daily life must be considered. Furthermore, it should be evaluated whether these symptoms fluctuate, relapse, improve or vanish over time, which can have a major impact on reactivation.

Regarding underwriting the most simple way to deal with post-COVID-19 condition is to postpone the application process and await the further course of this diagnosis. Still the question remains for how long to postpone and how to proceed if the symptoms or findings from medical examinations have reached a steady state condition.

In claims handling it will be essential to know exactly the definition of post-COVID-19 condition, its associated symptoms and the opportunities of medical examinations to potentially objectify the reported limitations.

Doubtlessly, in a considerable proportion of claims there will be no or too few objectifiable criteria available, hence it is impossible to directly conclude from the description of a symptom to a degree of working incapacity. In these cases, the degree of impaired work capacity – as with other diagnoses, too – will be the guiding factor to decide in underwriting and claims handling. The causative objective link between symptoms and the actual post-COVID-19 condition might not be decisive.

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3.4 Practice-oriented approach for the assessment of relevant symptoms during underwriting and claims process

This section aims for an understanding of post-COVID-19 symptoms and their assessment, verification and objectivity.
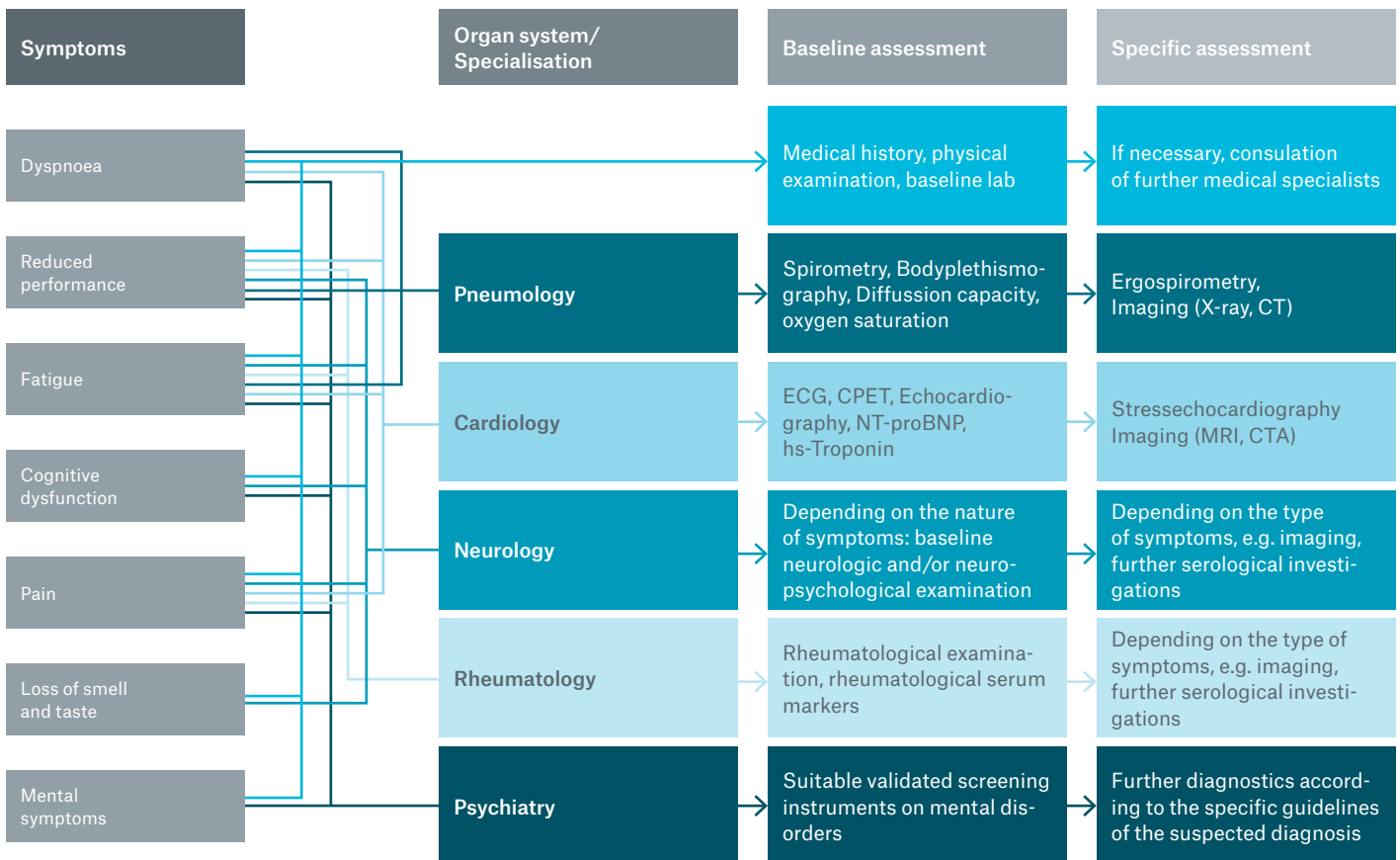
Post-COVID-19 condition is from our perspective a diagnosis of exclusion, which is in accordance with the WHO definition. Patients should be appropriately evaluated before reaching a final diagnosis to rule out other potential reasons for the reported symptoms. Depending on the kind and extent of symptoms, the medical work-up should include appropriate medical disciplines and respective examinations.

The first part of this section describes the most frequent symptoms which are assigned to the respective medical disciplines. The second part lists the recommended measurements in the respective medical disciplines.

Figure 2 provides an overview of the most common symptoms, their allocation to different medical disciplines and the recommended baseline as well as more specific assessments.

This flowchart contains a straightforward, interdisciplinary approach for the evaluation of post-COVID-19 condition. Multidisciplinary interaction is recommended, as complaints are usually not limited to one symptom. Rather most patients show a combination or even a multitude of different symptoms, leading to higher complexity. For underwriting and claims handling we recommend proceeding step-by-step starting with the leading symptom(s). Furthermore, we advise focussing on symptoms that are presumably contributing factors impacting on work and everyday life.

Figure 1: Flow-chart of the most common symptoms in post-COVID-19 condition and their appropriate assessment. Regardless of the symptoms (first column, left), a medical history, physical examination and baseline laboratory testing is recommended. The symptoms can be assigned to different organ systems/specializations (second column). The medical specialties assigned to the symptom, recommend a first baseline assessment (third column). In case of abnormalities or justified suspicion, a further specific assessment should be carried out (fourth column).

Symptoms	Organ system/ Specialisation	Baseline assessment	Specific assessment
Dyspnoea		Medical history, physical examination, baseline lab	If necessary, consulation of further medical specialists
Reduced performance	Pneumology	Spirometry, Bodyplethismography, Diffussion capacity, oxygen saturation	Ergospirometry, Imaging (X-ray, CT)
Fatigue	Cardiology	ECG, CPET, Echocardiography, NT-proBNP, hs-Troponin	Stressechocardiography Imaging (MRI, CTA)
Cognitive dysfunction	Neurology	Depending on the nature of symptoms: baseline neurologic and/or neuro-psychological examination	Depending on the type of symptoms, e.g. imaging, further serological investigations
Pain	Rheumatology	Rheumatological examination, rheumatological serum markers	Depending on the type of symptoms, e.g. imaging, further serological investigations
Loss of smell and taste			
Mental symptoms	Psychiatry	Suitable validated screening instruments on mental disorders	Further diagnostics according to the specific guidelines of the suspected diagnosis

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Symptoms

Baseline assessment of post-COVID-19 condition should include medical history, physical examination and laboratory testing. According to US guidelines (Centers for Disease Control and Prevention, 2021) and German guidelines (Koczulla AR et al., 2021) baseline laboratory analysis should contain a full blood count, electrolytes, parameters of renal function, liver function, thyroid function, inflammatory markers, and tests for vitamin deficiency (Table 1). A tool called post-COVID-19 functional status (PCFS) scale is proposed to measure the full spectrum of functional sequelae following COVID-19 (Klok FA et al., 2020). Further clinical and laboratory examinations depend on the specific symptoms and are outlined in the following sections.

3.4.1 Dyspnoea

Dyspnoea is a common and distressing symptom of post-COVID-19 condition. In patients with acute COVID-19, dyspnoea may persist, resolving slowly in most patients over two to three months, but eventually persisting longer and becoming the dominant symptom of post-COVID-19 condition. Dyspnoea usually occurs on exertion but can be even present at rest.

Underlying pathologies

– **Pulmonary origin**
COVID-19 infection is associated with a variety of different lung pathologies, including e.g. diffuse alveolar damage, acute fibrinous organizing pneumonia and lymphocytic pneumonitis. The most common imaging correlates are ground-glass opacities (Sonnweber T et al., 2020), which seem to decrease after some months of follow-up both in patients with mild and severe course (Han X et al., 2021).

– **Cardiovascular origin**
Cardiovascular complications are significantly increased in the first six months after COVID-19 (Nalbandian A et al., 2021). Dyspnoea is a hallmark of several cardiovascular conditions. These include myocarditis, myocardial infarction, pulmonary embolism and the occurrence of heart failure, which all have been reported with COVID-19.

– **Psychogenic origin**
Pulmonary and cardiovascular assessment could yield negative results. This could be due to a psychogenic origin, that needs further psychopathological assessment. Mental impairments causing dyspnoea are anxiety, panic disorder, psychological hyperventilation syndrome or compulsive sighing. However, psychogenic stress can also exacerbate primary diseases like asthma thus causing relevant dyspnoea.

– **Neuromuscular origin**
A neuromuscular pathology causing dyspnoea seems to be very uncommon in post-COVID-19 condition. A specialized workup can be added if other findings are negative and main causes have been excluded.

Measurement of dyspnoea

Besides a medical history and depending on the nature of dyspnoea and additional symptoms, functional tests at rest (especially body plethysmography, diffusion capacity and blood gas analysis) and/or during exercise (ergospirometry, if appropriate 6-minute walk test) should be performed (see Pulmonology section).

If necessary, cardiac diagnostics (ECG at rest, echocardiography, see Cardiology section) should be supplemented.

Depending on the aforementioned findings, further assessment in direction to psychological disorders (see Psychiatry section) could be necessary.

In case of indifferent or negative findings in cardiovascular, pulmonological and psychopathologic assessment, it can be a tedious process to objectify dyspnoea. In any case it is crucial to exclude further comorbidities (e.g. anaemia).

3.4.2 Reduced physical performance

Reduced physical performance includes any reduction of physical capability to perform tasks. In contrast, reduced mental performance will be addressed in the section of Cognitive dysfunction. Reduced physical performance is often accompanied by dyspnoea and/or fatigue. As physical activity is based on the functionality of several organ systems, reduced physical performance may be attributable to various causes. Diagnostic assessment is therefore challenging.

Underlying pathologies

– **Cardiovascular origin**
COVID-19 can cause myocarditis, myocardial infarction, pulmonary embolism and arrhythmias, leading to temporary or persisting heart failure symptoms associated with reduced physical performance.

– **Pulmonary origin**
Reduced physical performance can be caused by impaired pulmonary function due to COVID-19. The underlying lung pathologies are listed in the previous section.

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– **Neurologic origin**
Pathologic changes in the following systems can be caused by COVID-19 and reduce physical performance: central nervous system, sensory perceptual system, peripheral nervous system, and neuromuscular system.

– **Rheumatologic origin**
Rheumatologic symptoms may cause reduced physical performance. Persistent arm and leg weakness, joint pain and joint swelling with restricted motion have been reported with post-COVID-19 condition.

– **Psychogenic origin**
Psychological conditions associated with reduced physical performance include depressive disorders and anxiety disorders.

Measurement of reduced physical performance

In clinical practice there is a variety of tests to measure different aspects of physical performance (Simonelli C et al., 2021). Besides essential medical history, serious conditions should be ruled out by basic cardiovascular tests (see Cardiology section) and pulmonary function tests at rest. For further workup, pulmonary stress tests and imaging (see Pulmonology section) are recommended.

The 6-minute walk test (6MWT) is sensitive, reproducible and easy to perform and is the gold standard field exercise test. Nevertheless, being helpful in older patients with preexisting medical conditions, it might not be the optimal tool for an insurance population.

For our purpose we recommend conducting a cardiopulmonary exercise test (CPET) to measure the maximum workload, Borg scale and metabolic equivalent of task (MET). Despite some limitations, the MET concept provides a convenient method for describing the individual exercise tolerance and functional capacity.

In specific cases it could be helpful to add a neurological assessment including muscle strength tests and neurophysiological tests.

In case of elevated inflammatory parameters and/or accompanying symptoms like joint pain or swelling, a rheumatological assessment including baseline laboratory parameters (see Table 1, page 13) is advisable.

If the above-mentioned investigations are unobtrusive or mental impairment is suspected, psychological aspects should be taken into consideration.

3.4.3 Fatigue

Fatigue is one of the most commonly reported symptoms in the context of post-COVID-19 condition. Fatigue is challenging to define and objectify. As such, there is no single, broadly accepted international definition. Fatigue can be conceptualized as either a subjective feeling or a performance decrement. Fatigue is used to describe difficulties to initiate and or to maintain activity. Furthermore, difficulties with memory, concentration and emotional instability are covered under this term. Patients may report one or a combination of these symptoms, and they may occur alone or in conjunction with other complaints. Fatigue is a pathological feature of a variety of medical conditions, but also a natural reaction in healthy subjects.

Underlying pathologies

– **Viral infections**
It is known that viral infections can cause fatigue beyond the acute recovery phase. However, there is a strong association with specific viral infections such as Epstein Barr virus and human immune deficiency virus (Hickie I et al., 2006) and accordingly, SARS-CoV-2. The pathogenesis of fatigue after COVID-19 infection is still unclear and is element of current research (Raman B et al., 2021; Stussman B et al., 2021). It is presumed that a combination of COVID-19-related organ injury (e.g. lungs, heart, central nervous system, peripheral nervous system) and psychological factors are causing fatigue (Gaebler C et al., 2020).

– **Cardiovascular, pulmonary and neurologic dysfunction**
Organic diseases can cause substantial fatigue symptoms, which can be independent from reduced physical performance.

– **Autoimmune disease**
Fatigue is reported in several autoimmune diseases. As such, fatigue is the most common symptom of multiple sclerosis (MS), occurring in more than two thirds of patients with MS. Also, for COVID-19, low-grade inflammation or an autoimmune response is discussed (Rudroff T et al., 2020). Referral to a rheumatologist could be therefore advisable.

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Measurement of fatigue

Measurement of fatigue is a complex process, and the comprehensive understanding of this multifaceted phenomenon will require a broad approach integrating information gathered from physiological, cognitive, behavioral, affective and psychosocial factors.

A detailed medical history is the minimum requirement to distinguish pathological from non-pathological fatigue. Pathologic fatigue can have a longer duration, greater intensity and more disabling effects of functional activity. In addition, pathologic fatigue can manifest as chronic fatigue syndrome (CFS) lasting six months or more after onset of symptoms and following the exclusion of other causes of the condition.

Psychometric self-disclosure instruments such as Fatigue Scale (FS), Fatigue Severity Scale (FSS) or Fatigue Assessment Scale (FAS) are recommended to assess symptoms and severity of fatigue in a structured manner. The medical history should include screening questions for depression, sleep disorders and anxiety disorder, a clinical examination as well as laboratory diagnostics (see Table 1, page 13). Abnormal findings could require further workup by a specialist of the respective discipline to objectify the functional restriction on physical, cognitive and/or psychological level. It is important to exclude other causes of fatigue, because their treatment might lead to a significant improvement of fatigue.

There are some key features of fatigue necessitating specific organ assessment: One is exercise intolerance, meaning that physical or cognitive exertion leads to debilitating fatigue that is not alleviated by rest or sleep (Bested AC et al., 2015). So-called post-exertional malaise is very typical (Gaber T et al., 2021) and in that matter, it is substantial to perform a baseline cardiologic and pulmonological assessment (see Cardiology and Pulmonology section) to exclude underlying organic impairments.

Cognitive impairment and unrefreshing sleep are very common features, and many patients complain of recurrent headaches and generalised physical pain (Yancey JR et al., 2012). In severe cases dysautonomia and orthostatic intolerance are reported. Therefore, a neurologic assessment is recommended (see Neurology section).

If fatigue is accompanied by symptoms including myalgia or arthralgia, a rheumatologist should be consulted in any case (Sapkota HR et. al, 2021). The recommended rheumatologic measures are described in the Rheumatology section.

Assessment of mood disorders is necessary as both anxiety and depression are strongly associated with post-viral fatigue (Natelson et al., 2019) (see Psychiatry section).

3.4.4 Cognitive dysfunction

Cognitive dysfunction is an increasingly reported symptom after having recovered from COVID-19, in hospitalised as well as in non-hospitalised patients, independently of their socioeconomic and educational level (Hampshire et al., 2021).

Cognitive dysfunction can comprise impairments of memory, concentration, learning and decision-making that affect everyday life. Severity of cognitive dysfunction can range from mild to severe. With mild impairment, people may notice changes in cognitive functions, but still be able to perform their everyday activities. Severe impairment can lead to loss of understanding the meaning or importance of something and the ability to talk or write, resulting in the inability to live independently. Regarding disability insurance, the relevant grade of impairment largely depends on the previous professional activity. In some professions people with mild cognitive impairment will still be able to perform their occupation, whereas people with mild cognitive impairment in jobs with a high mental and cognitive demand (e.g. managing positions) might be significantly limited in their work ability.

In persons with post-COVID-19 condition, a term called brain fog is often reported. Brain fog is used to describe a range of symptoms, including trouble concentrating, feeling confused, thinking more slowly than usual, being forgetful and having difficulties finding the correct words.

Obviously, cognitive dysfunction can have a significant overlap with mental fatigue (see Fatigue section).

Underlying pathologies

– **Neurologic origin**
   Albeit not fully understood, patients with COVID-19 infection are prone to develop a range of neurological complications (Varatharaj A. et al., 2020), arising from several conditions such as stroke, microbleeds, encephalopathies and auto-immune response (Paterson RW et al., 2020 and Helms J et al., 2020).

– **Psychogenic origin**
   Psychological conditions can cause cognitive dysfunction, especially depressive disorders.

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Measurement of cognitive dysfunction

The recommended initial step is a basic neuropsychological examination focusing on the main symptoms including the Montreal Cognitive Assessment (MoCA) test. The Mini-Mental State Exam (MMSE), widely used as cognitive test in the elderly, should not be the tool of choice, as being less sensitive in the insurance population of younger persons.

However, it must be pointed out that MoCA test may stay unobtrusive in people with post-COVID-19 condition. Limitations could only get obvious after a certain amount of time in mentally demanding jobs with high cognitive needs. In this case, it might be advisable to add a test of alertness (part of neuropsychological testing (see Figure 3) at baseline and repeat the test after two hours.

If there are any abnormalities in the initial assessment, a detailed neuropsychological examination is recommended (see Figure 3), including tests for memory performance, executive functions, visual-spatial skills, perception, alertness and concentration.

All these examinations should be carried out by specialized neuropsychologists.

Impairments in cognitive performance are often accompanied by emotional-affective changes (e.g. depressive disorders, anxiety, post-traumatic stress disorder) and, therefore, should be screened for (see Psychiatry section).
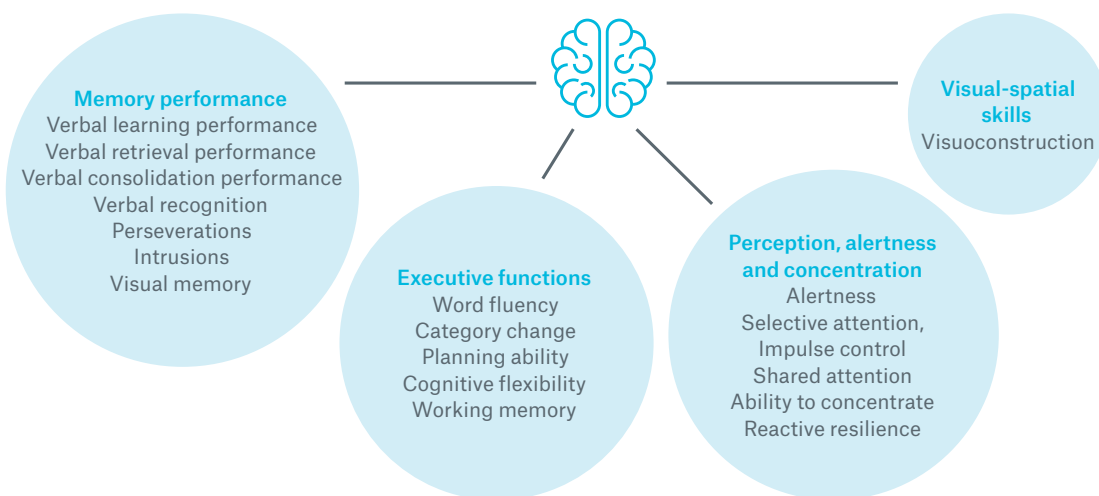
3.4.5 Pain

Developing chronic pain after acute COVID-19 is a common symptom in the context of post-COVID-19 condition and is usually combined with other complaints, especially fatigue. The nature of pain can include headache, muscle and joint pain, chest pain and neuralgia.

Underlying pathologies

The pathogenetic classification of pain distinguishes between organic, neuropathic and psychogenic pain, all of which are described in post-COVID-19 condition. The following list shows different locations of pain and its cause in post-COVID-19 condition:

– **Headache**
  · Migraine-like and/or tension headache, new daily persistent headache
  · Secondary to COVID-19 associated cerebrovascular diseases

– **Muscle and joint pain**
  · Non-inflammatory and multilocular (form of fibromyalgia). Overlapping with CFS is possible
  · Polyarthritis, similar to rheumatoid arthritis
  · Polyarthralgia, similar to collagenoses
  · Critical illness myopathy

Figure 3: Sub-areas of neuropsychological examination. Depending on the nature of symptoms, attention should be paid to the affected areas. Since the test methods used are not uniform worldwide and various online tools are increasingly being used, we have refrained from listing specific test methods here.

Memory performance
Verbal learning performance
Verbal retrieval performance
Verbal consolidation performance
Verbal recognition
Perseverations
Intrusions
Visual memory

Executive functions
Word fluency
Category change
Planning ability
Cognitive flexibility
Working memory

Perception, alertness and concentration
Alertness
Selective attention,
Impulse control
Shared attention
Ability to concentrate
Reactive resilience

Visual-spatial skills
Visuoconstruction

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– **Chest pain**
  · Cardiac chest pain (caused by heart pathologies such as coronary ischaemia)
  · Non-cardiac chest pain (e.g. gastrointestinal, musculo-sceletal)

– **Neuralgic pain**
  · Primary neuralgia
  · Nerve pain after COVID-19 associated neurological complications

Measurement of pain

A detailed medical history including screening questions for depression, insomnia, anxiety disorder and pain-related fear, and a thorough physical examination are necessary. Laboratory diagnostics should be accompanied depending on the leading symptoms.

To assess symptoms and severity of chronic pain it is recommended to use psychometric self-reporting tools, like the Brief Pain Inventory (Radbruch L et al., 1999). Depending on the localization and type of pain, specific questionnaires (e.g. New Clinical Fibromyalgia Diagnostic Criteria, Fibromyalgia Survey Questionnaire, Kieler Kopfschmerzkalender, Neuropathic Pain Diagnostic Questionnaire) should be applied.

In case of the suspicion of an inflammatory rheumatic disease, a neuropathic disorder, a fibromyalgia syndrome or in case of unclear headache symptoms, a specialist in neurology, rheumatology and/or pain medicine should be involved.

Chest pain must be seen as a separate entity, as it requires first line cardiological evaluation. Basic cardiac assessment (see Cardiology section) including ECG at rest, Echocardiography and hs-Troponin and NT-pro-BNP is recommended. Only after excluding relevant cardiological pathologies, further diagnostics regarding e.g. gastrointestinal and neuromuscular causes are to be performed.

3.4.6 Loss of smell and taste

Changes in or loss of smell and taste are odd but common phenomena in post-COVID-19 condition. Loss of smell and taste affects more than 40% of all COVID-19 patients (Hopkins C et al., 2021). But less than 10% have ongoing symptoms after 6 months (Otte MS et al., 2021).

Even if the impact on work ability and daily activities might be negligible for most existing occupations, there are others like sensory researcher or cooks/chefs where a functioning olfactory sense is mandatory.

Smell disorders can be subdivided into quantitative and qualitative olfactory disorders: Normosmia indicates normal function, hyposmia reduced and anosmia is a very clear restriction or loss of smell. Parosmia describes the changed perception of smells in the presence of a source of irritation (Koczulla et al, 2021). In the general population, hyposmia occurs in around 15% and functional anosmia in around 4% (Damm M et al., 2019).

Underlying pathologies

– **Neurologic origin**
  The pathogenesis of COVID-19 anosmia is under investigation and has not yet been fully defined. However, potential mechanisms are olfactory bulb damage and/or olfactory cleft inflammation or obstruction (Han AY et al., 2020).

Measurement of loss of smell and taste

Hyposmia or anosmia should be objectified with olfactory function evaluation, or scent recognition. Fragrances are identified using standardized lists, e.g. the Sniffin Sticks Test (Hummel T et al., 1997) or the University of Pennsylvania Smell Identification Test (Doty RL et al., 1984). A more precise diagnosis is made by collecting an olfactory threshold (e.g. with rose scent dilution series) and the differentiation of scents. This tests can be conducted by an ENT specialist or neurologist. In addition, an examination of the olfactory bulb using magnet resonance imaging (MRI) may be performed (Kandemirli SG et al., 2021).

3.4.7 Mental symptoms

Psychiatric and psychosomatic sequelae of COVID-19 have been widely reported (COVID-19 Mental Disorders Collaborators, 2021). It is a major challenge – not only in insurance medicine – that mental diseases are on the rise and could have been accelerated by this pandemic with such a major socio-economic impact.

Mental symptoms after COVID-19 include fatigue (see Fatigue section), depression, anxiety disorder, posttraumatic stress disorder (PTSD), obsessive compulsive disorder, somatization disorder, adaption disorder, sleep disturbances, psychosis and suicidality.

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Underlying pathologies

– **Psychogenic origin**
Mental symptoms are currently not only seen as a result of infection with COVID-19, but they are also linked to the burden of the pandemic and persistent limitations and restrictions and economic strain. There is evidence that previous psychological and psychosomatic illnesses are associated with a higher vulnerability for the occurrence of psychological symptoms after COVID-19 infection. In addition, neuroimmunologic concepts suggest that stress may contribute to deterioration and chronification of inflammatory processes (Peters EMJ et al., 2021).

– **Organic origin**
An organic cause (manifest cerebral inflammation, electrolyte disturbances) should be excluded.

Measurement of mental symptoms

The distinction between psychological and organic causes of symptoms in post-COVID-19 condition often poses a diagnostic challenge. Numerous symptoms cannot clearly be assigned to a single category.

In case of a clinical suspicion of psychological or psychosomatic symptoms after COVID-19 a mental health screening is recommended, using suitable validated screening instruments (see Psychiatry section). Further diagnostics regarding a particular psychiatric diagnosis should be performed by a psychiatrist, if necessary.

3.5   Assessment according to medical disciplines

3.5.1 Pulmonology

A pulmonological assessment is based on these three columns:

Pulmonary function tests at rest

Pulmonary function tests at rest are noninvasive tests measuring lung volume, capacity, rates of flow, and gas exchange.

– Spirometry is a simple, basic test of lung function. It can be offered by general practitioners and is the key diagnostic test for airway diseases such as asthma and chronic obstructive pulmonary disease (COPD). However, it should be noted that spirometry would not be able to indicate changes at the distant small airways that are primarily affected in COVID-19.

– Therefore, one should add body plethysmography measuring diffusion capacity (DLCO). Parameters of interest are total lung capacity (TLC) and specific airway resistance (sRaw). These parameters are not assessable by conventional spirometry. Notably, body plethysmography is less affected by the patient's cooperation, and thus more objective than spirometry.

– Both tests are combined with measurement of oxygen saturation of the blood (arterial blood gas analysis).

Pulmonary function tests during exercise

Exercise tests are used in case of exercise-associated symptoms to assess aerobic capacity and endurance.

– The 6-minute walk test (6MWT) is a simple test with the purpose to measure exercise tolerance. It measures the distance an individual can walk over a time of 6 minutes on a flat surface, the 6-minute walk distance. The 6MWT is reproducible, but unspecific, as it is affected by pulmonary, cardiovascular and musculosceletal impairments.

– Ergospirometry combines the examination of the comprehensive reaction of a person`s heart, lung, vascular and metabolic system under physical stress. It is usually carried out sitting or lying on a treadmill with a continuous respiratory gas analysis, often combined with ECG monitoring, enabling an objective view on exercise performance and patient's cooperation with the test.

Imaging

Medical algorithms recommend that patients with dyspnoea and functional limitations first perform a conventional chest x-ray. If abnormal findings are found in chest x-ray or the above-mentioned pulmonary function diagnostics, a CT scan (including CT angiography) or, if available, a Dual Energy CT, should be discussed. CT can detect structural changes like progressive interstitial lung processes. A pathologic finding could trigger further bronchoscopy with bronchoalveolar lavage and, if necessary, a biopsy.

3.5.2 Cardiology

In addition to pulmonological diagnostics, all patients who suffer from ongoing symptoms of potentially cardiac origin after acute COVID-19 infection such as shortness of breath, reduced physical performance, palpitations, chest pain and fatigue, should receive a basic cardiovascular assessment.

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Basic assessment

The basic assessment should include an ECG at rest, an echocardiography and laboratory test on NT-pro-BNP (as a parameter for heart failure) and high-sensitive troponin (as a parameter of myocardial injury). In addition, a cardiopulmonary exercise test (CPET, e.g. treadmill test) is recommended. With these measures one should be able to at least exclude the most serious cardiac complications after COVID-19.

Advanced diagnostic

In case of pathological or indefinite findings in the above-mentioned basic assessment, further cardiac workup should be discussed, including cardiac MRI to rule out inflammatory processes and fibrotic changes as seen with myocarditis. Stress echocardiography and subsequent CT angiography is advisable to rule out coronary artery disease if typical symptoms are present. Since thromboembolic complications are common in COVID-19, pulmonary embolism should be excluded with CT or other means if there is clinical suspicion according to current guideline recommendations.

3.5.3 Neurology

Due to the variety of neurologic symptoms of post-COVID-19 condition, including cognitive dysfunction, fatigue, reduced performance, pain and loss of smell and taste, a neurological investigation should be carried out by a neurologist, or, in case of fatigue and cognitive deficiency, by a neuropsychiatrist (specialized in both neurology and psychiatry).

Basic assessment

Basic assessment should include a neurological history and a profound neurological examination to reveal neurologic impairments. In most cases a tentative diagnosis can be made.

Advanced assessment

All further investigations should be carried out after basic assessment according to the suspected diagnosis. These further diagnostic steps can comprise of carotid and transcranial ultrasound, electroencephalography (EEG), electromyography (EMG), cerebral imaging (CT, MRI), laboratory testing (e.g. liquor analysis) and/or further neuropsychological examinations.

3.5.4 Rheumatology

For the evaluation of post-COVID-19 condition, a systemic autoimmune or rheumatic disease should be considered as a differential diagnosis as several rheumatic diseases may mimic post-COVID-19 condition. In fact, Vlachoyiannopoulos et al. (2020) reported that 69% of patients with severe acute COVID-19 were found to have positive autoantibody titers (e.g. antinuclear antibodies, anti-cardiolipin antibodies).

Basic assessment

Inflammatory markers and/or typical combinations of symptoms suspicious for rheumatic or autoimmune disease should trigger a baseline rheumatological assessment including the most common inflammatory cytokines (Interleukin 6, tumour necrosis factor alpha and soluble interleukin 2-receptor) and autoantibodies (anti-nuclear antibody, rheumatoid factor, anti-cyclic citrullinated peptide, anti-cardiolipin, and creatine phosphokinase) is recommended. Although the pattern of autoantibodies found in COVID-19 is thought to be a reactive phenomenon (Sapkota HR et al., 2021), the presence of strongly positive autoantibody titers would encourage further workup for autoimmune rheumatic disease.

Advanced assessment

In the presence of a multitude of symptoms, the rheumatologist is probably the best expert to bring these symptoms into a context and distinguish between unspecific findings and a clear rheumatologic diagnosis. In addition, a targeted medical history appears to be useful, whereby questionnaires such as the Connective Tissue Disease Screening Questionnaire can also be helpful. Further diagnostics such as imaging or further serological investigations should be determined by a rheumatologist in case of abnormalities.

3.5.5 Psychiatry

If signs of an underlying psychiatric condition are suspected, an according screening is recommended.

Baseline assessment

We recommend using suitable validated screening instruments (see Table 1, page 13), including Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder-7 (GAD-7), Hospital Anxiety and Depression Scale (HADS), Screening für Somatoforme Störungen (SOMS) and Impact of Event Scale-Revised (IESR). A detailed medical history on psychiatric disorders should be mandatory.

Advanced assessment

Based on the detailed medical history by a psychiatrist, a particular diagnosis may be suspected, and further diagnostics should be performed according to the specific medical guidelines. Additional radiological imaging (CT, MRI) could also become necessary in selected cases to rule out organic causes of mental symptoms. For the comprehensive assessment a referral to specialized psychiatric center is appropriate.

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**Table 1: List of recommended examinations for the assessment of post-COVID-19 condition.
Order is by specialty and assigned symptoms.**

Blood examinations

Blood values	Parameters		Conventional	SI-units
Blood count, electrolytes and renal function	Red cell count	Female	4.3–5.5million/mm^3	4.5–6.0X10^{12}/l
		Male	4.5–6.0million/mm^3	4.5–6.0X10^{12}/l
	White cell count		4,000–11,000/µL	4.0–11·10^9/L
	Haemoglobin	Female	12–16 g/dL	7.5–9.9 mmol/L
		Male	14–18 g/dL	8.7–11.2 mmol/L
	Haematocrit	Female	40–48%	0.40–0.48
		Male	42–52%	0.42–0.52
	MCV			80–100 fl
	MCH		27–32 pg/RBC	1.7–2.0 fmol/cell
	MCHC		31–35 g/dL	19–22 mmol/L
	Red cell distribution width (RDW)		11.9–14.5%	0.119–0.145
	Glucose		70–100 mg/dl	3.9–5.6 mmol/l
	Calcium		8.5–10.5 mg/dl	2.2–2.6 mmol/l
	Sodium		136–152 mval/l	136–152 mmol/l
	Potassium		3.5–5.0 mEq/l	3.5–5.0 mmol/l
	Chlorid		95–105 mEq/l	95–105 mmol/l
	Blood urea nitrogen (BUN)		3.6–22 mg/dl	0.6–3.6 mmol/L
	Creatinine	Female	0.5–1.0 mg/dL	44–88 µmol/L
		Male	0.5–1.2 mg/dL	44–106 µmol/L
	Urinanalysis			
Liver function	ALT (GPT)	Female	≤ 35 U/L	≤ 0.60 µkat/L
		Male	≤ 50 U/L	≤ 0.85 µkat/L
	AST (GOT)	Female	≤ 35 U/L	≤ 0.60 µkat/L
		Male	≤ 50 U/L	≤ 0.85 µkat/L
	Alkaline phosphatase (ALP)	Female	35–104 U/L	0.58–1.74 µkat/L
		Male	40–129 U/L	0.67–2.15 µkat/L
	GGT	Female	≤ 40 U/L	≤ 0,67 U/L
		Male	≤ 60 U/L	≤ 1,00 U/L
	Bilirubin		≤ 1.2 mg/dL	≤ 20.52 µmol/L
	Albumin		3.1–4.3 g/dL	31–43 g/L
Inflammatory markers	CRP		≤ 5 mg/L	47.6 nmol/L
	Ferritin		13–200 ng/mL	29–449 pmol/L
	Erythrocyte sedimentation rate (ESR)	< age 50	15–20 mm/hr	
		≥ age 50	20–25 mm/hr	
Thyroid function	TSH		0.3–3.1 µU/ml	0.3–3.1 mU/l
	fT4		0.8–2.3 ng/dL	10.20–29.4 pmol/L
Vitamin deficiency	Vitamin D		40–80 ng/ml	100–200 nmol/L
	Vitamin B12		200–1000 ng/l	147.5–737.8 pmol/L

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Organ system/ Medical discipline	Associated symptoms	Baseline	Parameters/Tools	Normal values
Pulmonology	Dyspnoea, Reduced performance, Fatigue	Bodyplethysmography	Total lung capacity (TLC)	6.0 to 8.0 L
			Specific airway resistance (sRaw)	Interpretation by pulmonologist
		Diffusion capacity[1]	Diffusion Capacity of the Lungs for Carbon Monoxide	> 75% of predicted value, up to 140%
		Oxygen saturation	Oxygen saturation	65–100 mmHg (8.7–13.3 kPa) [Male: 100–0.33 * age +/– 10 mmHg; Female: 98–0.32 * age +/– 10 mmHg]
Cardiology	Reduced performance, Dyspnoea, Fatigue	ECG		Evaluation by an experienced physician
		CPET	Maximum work load	Reference values depending on age, body weight and body height
		Echocardiography[2]	Left ventricular ejection fraction (LV-EF)	≥ 50%
			Right ventricular function	Interpretion by a cardiologist
		Laboratory parameters	NT-pro-BNP	Female: ≤ 150 pg/mL (17.7 pmol/L)
				Male: ≤ 100 pg/mL (11.8 pmol/L)
			High sensitive-Troponin	< 14 ng/L (< 14 mcg/l)
Rheumatology	Fatigue, Pain, Reduced performance	Questionnaire	Connective Tissue Disease Screening Questionnaire	
			New Clinical Fibromyalgia Diagnostic Criteria	
			Fibromyalgie-Symptomfragebogen (German) or similar	
		Laboratory parameters	Interleukin 6	< 5 ng/l
			Tumour nekrosis factor (TNF) alpha	< 8.1 ng/ml
			Soluble interleukin 2-receptor	223–710 U/ml
			Antinuclear antibodies (ANAs)	< 1:160
			Rheumatoid factor (RF)	< 20 IU/ml
			Anti-cyclic citrullinated peptide antibodies (ACPA)	< 20 IU/ml
			Anti-cardiolipin antibodies (ACA)	< 10 U/ml
			Creatine phosphokinase (CPK)	Female: 26–192 U/l
				Male: 39–308 U/l

[1] Mild impairment: 60–75%
  Moderate impairment: 40–60%
  Severe impairment: < 40%

[2] Mild impairment: 40–49%
  Moderate impairment: 30–39%
  Severe impairment: < 30%

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Organ system/ Medical Discipline	Associated symptoms	Baseline assessment	Parameters/Tools
Neurology	General	Questionnaire	Neurobehavioral Symptom Inventory
	Fatigue	Questionnaire	Fatigue Severity Scale (FSS)
			Fatigue Scale (FS)
			Fatigue Assessment Scale (FAS)
			Wood Mental Fatigue Inventory (WMFI)
	Cognitive deficiency	Questionnaire	Montreal Cognitive Assessment (MoCA)
		Neuropsychological examination[1]	See Figure 2
	Pain	Questionnaire	Brief Pain Inventory
			New Clinical Fibromyalgia Diagnostic Criteria,
			Fibromyalgie-Symptomfragebogen (german) or similar
			Kieler Kopfschmerzkalender (German) or similar
			Neuropathic Pain Diagnostic Questionnaire (DN2)
	Loss of smell and taste	Standardized tests[2]	Sniffin' Sticks
			Smell Identification Test UPSIT
Psychiatry	Mental symptoms, Pain, Fatigue, Cognitive deficiency, Dyspnoea, Reduced performance	On suspicion of anxiety disorder	General Anxiety Disorder-7 (GAD-7)
			Hospital Anxiety and Depression Scale (HADS)
		On suspicion of depressive symptoms	Patient Health Questionnaire-9 (PHQ-9)
			Hospital Anxiety and Depression Scale (HADS)
		On suspicion of posttraumatic stress disorder (PTSD)	PTSD Symptom Scale (PSS)
			Screen for Posttraumatic Stress Symptoms (SPTSS)
			PTSD Checklist for DSM-5 (PCL-5)
			Impact of Event Scale-Revised (IESR)
		On suspicion of somatoform disorder	Screening für Somatoforme Störungen (SOMS) (German)

[1] The neuropsychological examination is carried out by psychiatrists or neuropsychologists.

[2] These tests are also performed by ENT (ear, nose and throat) specialists.

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4   Discussion

Due to the current broad definition of post-COVID-19 condition, a plethora of symptoms can be related to this syndrome. Both clinically specific organ-related manifestations and unspecific symptoms that cannot be assigned to a distinct organ or disease, fall under this current definition. As the number of possible symptoms in post-COVID-19 condition has risen beyond 200 entries, we must point out that our recommendations can only cover the most important symptoms. Therefore, we focused on symptoms that might have the greatest impact on underwriting and claims handling within the life and health insurance business.

Most patients with post-COVID-19 condition show a combination of symptoms, that are mutually dependent. Our approach deals with symptoms separately in different sections and represents a concise and easy-to-handle form. We recommend to focus on leading symptoms, that have presumably the largest impact on work ability.

It is obvious, that some symptoms in post-COVID-19 condition can be objectified by simple tests, whereas others require either comprehensive testing or will remain impossible to objectify. As such, we recommend a stepwise approach for clarification with standardized tests, and further examinations or specific consultations if needed. The problem of objectifiability is also known for other diseases, which affects in particular UW and claims handling. However, post-COVID-19 condition seems to be more complex, as there is usually a certain combination of symptoms that first have to be assigned to the specific medical discipline. We believe that when organic findings are present and objectified, other less objectifiable symptoms from other areas or organ systems are better understood. For individuals with post-COVID-19 condition that only reports less objectifiable symptoms, it remains a similar challenge as for other diseases with unspecific symptoms and reduced objectifiability. As the WHO has stated, post-COVID-19 condition remains a diagnosis of exclusion and all differential diagnoses should be considered as part of an appropriate, guideline-recommended medical workup.

It is worth mentioning that in the case of COVID-19, there is a clear focus of research on the post-viral phase of an infectious disease. Knowledge is growing continuously, but is still limited, in part due to the previously diverging definitions for health-related problems after COVID-19. It is likely that within the next months to years, research will uncover new findings about post-viral disease. This knowledge will improve our understanding of how a post-viral condition develops and which symptoms are clearly associated with the pathologic process rather than the environmental factors that are currently in play during this pandemic.

Notably, most symptoms in post-COVID-19 condition tend to fluctuate and diminish over time, which will undoubtedly influence decisions in underwriting and claims handling. Long-term follow-up data of large cohorts with post-COVID-19 condition beyond 12 months after the acute infection is still limited, and we have to await further results from research and real-world underwriting and claims experience. In this regard, it is important to highlight that implementing regular reassessment, especially in regards of reactivation, is recommended.

Our recommendations could facilitate assessment of post-COVID-19 condition from an insurance medicine perspective. Focusing on the most prevalent and disabling symptoms known, we provide a stepwise approach to enable colleagues in the underwriting and claims handling to understand this condition better and gather data for informed decisions for their clients.

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