

Case Report

## Use of Homeopathy in Patients Suffering from Long COVID-19 (LONGCOVIHOM): A Case Series

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**Academic Editor:** Peta Stapleton

*OBM Integrative and Complementary Medicine*  
2024, volume 9, issue 3  
doi:10.21926/obm.icm.2403045

**Received:** May 04, 2024

**Accepted:** July 22, 2024

**Published:** August 06, 2024

### Abstract

In some patients, coronavirus (COVID-19) can cause symptoms that last weeks or even months after the infection has gone. Long COVID-19 was defined as a confirmed initial COVID-19 infection, the presence of signs and symptoms more than four weeks after initial



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infection, and the persistence or appearance of signs and symptoms that another condition cannot explain and did not exist before infection. This study aimed to describe the effect of adjunctive individualized homeopathic treatment delivered to Long COVID-19 patients with previously confirmed symptomatic SARS-CoV-2 infection. Fifteen female consecutive patients with Long COVID-19 were documented. The mean age was  $48.5 \pm 13.5$  (SD) years. The symptoms of Long COVID-19 were diverse. None of the patients showed identical symptoms. All but one patient, hence 93.3%, experienced a timely improvement to complete healing after individualized homeopathic treatment, characterized by modified Naranjo criteria of at least 8 points. The average time until improvement/remission was  $47.6 \pm 34.6$  days, and the median was 37 days. Our observations suggest that adjunctive individualized homeopathic treatment might be considered for patients suffering from Long COVID-19 even with severe long-term sequelae of COVID-19.

### **Keywords**

Complementary therapy; COVID-19; homeopathy; Long COVID-19; SARS-CoV-2

## **1. Introduction**

Long-lasting health effects after surviving COVID-19 infection may include long-term breathing problems, heart complications, chronic kidney impairment, stroke, and Guillain-Barré syndrome [1]. In patients with COVID-19 who survived for at least 30 days after diagnosis, Al-Aly et al. showed that beyond the first 30 days of illness, people with COVID-19 exhibit a higher risk of death and use of health resources [2]. The authors' high-dimensional approach identifies incident sequelae in the respiratory system and several other sequelae that include nervous system and neurocognitive disorders, mental health disorders, metabolic disorders, cardiovascular disorders, gastrointestinal disorders, malaise, fatigue, musculoskeletal pain and anemia. They show increased incident use of several therapeutic agents-including pain medications (opioids and non-opioids) as well as antidepressant, anxiolytic, antihypertensive and oral hypoglycaemic drugs, as well as evidence of laboratory abnormalities in several organ systems [2]. Early reports suggest residual effects of SARS-CoV-2 infection, such as fatigue, dyspnea, chest pain, cognitive disturbances, arthralgia, and decline in quality of life [3]. Cellular damage, a robust innate immune response with inflammatory cytokine production, and a pro-coagulant state induced by SARS-CoV-2 infection may contribute to these sequelae [3].

A recent paper described the effect of adjunctive homeopathic treatment delivered to hospitalized patients with moderate to severe COVID-19 symptoms [4]. All patients admitted with confirmed SARS-CoV-2 infection during one month received individualized homeopathic treatment using homeopathic medical products (HMPs) in addition to their conventional care. Thirteen patients with COVID-19 were admitted. Twelve (92.3%) were speedily discharged without relevant sequelae. A time-dependent improvement of appropriate clinical symptoms was observed in these 12 patients. One patient admitted in an advanced stage of septic disease died in hospital. Six study participants (46.2%) were critically ill on admission and treated in the intensive care unit (ICU). In six patients (46.2%) gastrointestinal disorders accompanied COVID-19. Adjunctive

individualized homeopathic treatment may be helpful in treating patients with confirmed COVID-19. Low costs, easy application, and good tolerance favor the use of homeopathy [4]. Encouraged by the positive experience of homeopathic treatment in patients affected by COVID-19, individualized homeopathic treatment was initiated in patients suffering from LongCOVID-19 symptoms.

Long COVID-19 was defined as a confirmed initial COVID-19 infection, the presence of signs and symptoms more than four weeks after initial infection, and the persistence or appearance of signs and symptoms that another condition cannot explain and did not exist before infection. Symptoms of Long COVID-19 include but are not limited to extreme tiredness (fatigue), feeling short of breath, problems with memory and concentration ("brain fog"), heart palpitations, dizziness, joint pain, and muscle aches. According to an international consensus, the term "post-COVID condition" was established by the WHO in October 2021 as compatible symptoms three months after infection that lasts for at least two months and for which no other cause can be found [5].

In the following, we describe 15 documented case reports. No official data regarding the prevalence of Long COVID-19 is known in Austria. According to estimates by the Office of National Statistics, between 350,000 and 850,000 people could also be affected by Long COVID-19 in Austria, roughly estimated based on the number of cases to date, considering multiple infections. From the start of the pandemic to April 2022, 46,000 sick days due to Long Covid-19 were reported to the Austrian Health Insurance Fund (ÖGK). This blog analyzes data from the Austrian Corona Panel Project (ACPP) from April 2022 to determine how many people are affected by Long Covid-19 according to self-assessment and which symptoms occur most frequently.

## **2. Materials and Methods**

### **2.1 Ethics**

The authors confirm that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. The Ethics Committee of the Medical University of Innsbruck, Austria, has approved the study with the EK-Nr 1087/2023, as of August 8, 2023. Informed consent was obtained from all subjects involved in the study. ClinicalTrials.gov Identifier: NCT06002230 published August 2023. The manuscript is in line with the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals and aimed to include representative human populations (sex, age and ethnicity) as per those recommendations.

### **2.2 Patients**

All consecutive patients treated at the office in Lienz, Austria, of one of the authors (M.T.) between January 5th, 2021, and October 19th, 2021, with continued or newly developed Long COVID-19 symptoms following SARS-CoV-2 infection, were included in this Case series.

All patients were mild to moderate cases, and none had been previously admitted to the intensive care unit due to SARS-CoV-2 infection. Only female patients showed up in the office; although male patients were not primarily excluded. Data were derived from the treating homeopathic doctor, who has a homeopathic diploma from the Austrian Medical Association and 30-years' experience (M.T.).

### **2.3 Physicians**

The homeopathic physician treated all Long-COVID-19 patients by individualized homeopathy. In some cases, he contacted experienced colleagues for professional support. Repertorization of the symptoms of the current pandemic and a search in the current homeopathic literature on COVID-19 was performed using a computer program (Mac repertory MR 8.5.3.4 Professional, February 2018, Synergy Homeopathic Head Office: Hahnemann Clinic 1220 Brickyard Cove Road #101, Richmond, CA 94801, USA). The treating physician could choose all available homeopathic medicinal products (HMPs).

### **2.4 Administration of Homeopathic Medication**

Following prescription, five globules of the respective HMP were administered sublingually, where they dissolved. In some cases, five globules of the respective HMP were dissolved in a glass filled with about 125 ml of tap water. Then, the patient took one sip of advice. HMPs were manufactured by Remedia, Eisenstadt, Burgenland, Austria, and Homeocur, Retz, Lower Austria, Austria. All HMPs are registered according to the EU Directive 2001/83 and prepared following the instructions of the European Pharmacopoeia [6, 7]. During this preparation process, HMPs are highly diluted and succussed, resulting in so-called homeopathic “potencies.” All HMPs were administered as globules in CH200 potencies as prescribed. For “CH-potencies” the original substance is diluted 1:100, followed by 10 succussions per dilution step. Principles of homeopathy, including selection of medicine and preparation of potencies, have been described elsewhere [8]. Unless otherwise stated, medication was given once daily. No other conventional medicine was given in these cases.

### **2.5 Primary Diagnostic Procedures for COVID-19**

All patients had tested positive for SARS-CoV-2 before having developed Long COVID-19 symptoms. The following testing methods were carried out in each patient to analyze a SARS-CoV-2 infection: polymerase chain reaction (PCR) EGen; PCR RdRP-Gen; PCR N-Gen (kits manufactured by TIB-Molibiol, Berlin, Germany) [9]; positive results were confirmed by a commercial assay targeting the S-Gen (Altona-Diagnostics, Hamburg, Germany) and an in-house PCR targeting the ORF-8. For a confirmed infection, at least 3 of these 5 tests had to be positive. Tests for the orthomyxoviruses influenza A and B, human metapneumovirus (hMPV), and paramyxoviruses were negative unless stated otherwise.

### **2.6 Evaluation of the Modified Naranjo Criteria**

Case reporting follows HOM-CASE guidelines [10]. Modified MONARCH criteria were assessed post hoc by all authors. Deviations were solved by discussion in person. The clinical outcome of case reports was evaluated using the “Modified Naranjo Criteria for Homeopathy-Causal Attribution Inventory” [11]. Six points is the limit for potential correlation between homeopathic therapy and amelioration of the symptoms or healing in acute cases. In comparison, eight points is assumed as the limit in chronic cases [11].

### 3. Results

In the follow-up of the case reports, changes in the interventions and possible causal attribution of changes have been explicitly assessed and discussed [12]. In cases where it is not clear from the description, the prescription is mentioned as individualized, repertorized, or specific in brackets after the HMP. The conventional treatments were not mentioned, as they would go beyond the scope of this paper and the symptoms did not improve despite constant conventional therapy. The influence of conventional therapy specifically for Long-COVID-19 symptoms can, therefore, be neglected.

#### 3.1 Case 1

A female patient without previous illnesses and any medication contracted a COVID-19 infection on November 19th, 2020, on her 42nd birthday. She reported stomach and abdominal pains, nausea associated with loss of appetite, body aches, a strong feeling of cold, and increased body temperature from 37.5°C to 37.9°C. Although the acute COVID-19 disease subsided at the end of November, as confirmed by a negative SARS-CoV-2 test, the patient continued to suffer from the following symptoms: metallic taste, nausea, feeling cold, inner restlessness, depressive mood, circulatory problems, and weakness. Palpation led to an increase in abdominal pain. Homeopathic treatment started on January 5th, 2021. On the first day, she was given *Influenzinum CH200* to clear up the acute disease state, and from the second day on *Nux vomica CH200 (individualized)* once daily as the upper abdominal symptoms were in the foreground until January 10<sup>th</sup>, 2021. While the inner cold disappeared, energy increased every day, but the nausea was improved only by 10%. Since the patient had become sensitive to odors, she received *Sepia CH200* once daily until January 17th, 2021, due to this key note typical of *Sepia*. On January 18th, 2021, the nausea and abdominal pain had improved significantly, and loud intestinal noises occurred at night. Following Hahnemann's description of rumbling in the evening and incarceration of flatus moving about in the abdomen [13], *Sepia* was continued until January 23, 2021, followed by *Sulphur CH200*, *Sepia's* follow-on HMP, from January 24th, 2021, onwards once daily for three days. No more abdominal noises could be auscultated within 3 days of *Sepia* administration. Abdominal palpation was now painless. On January 26th, 2021, the patient reported that the tiredness, weakness, and depressed mood had improved significantly with *Sepia*. With even slight nausea, the patient felt 99% healthy. She now receives *Sepia* once a week for 1 month, then once a month for 2 months. With repertorization done before the prescription, as in all other cases, *Sepia* was seen as the central HMP for her COVID-19 and Long-COVID-19 disease, so the further prescription was for 2 months without recurrence of disease during follow-up for 8 months (Figure 1).

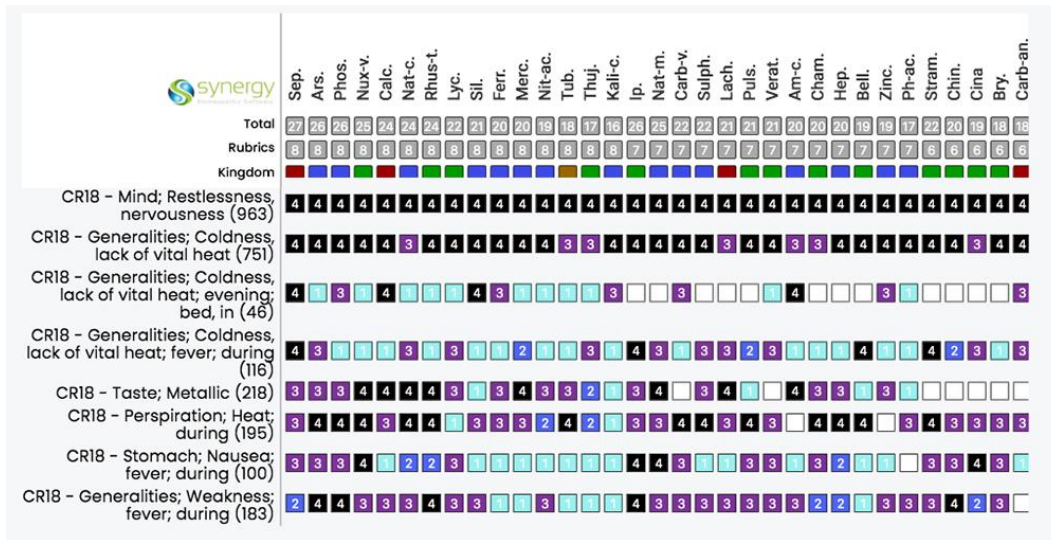


Figure 1 Repertorisation Case 1.

### 3.2 Case 2

A 25-year-old female patient was tested positive for SARS-CoV-2 at the end of October 2020. She suffered from a dry cough, fever up to 38°C, and severe shortness of breath with previously known bronchial asthma. Since then, there has been a great weakness, the patient cannot tolerate stress, has repeated aphthous ulcers and is short of breath on exertion. Auscultation of the lungs revealed asthmatic noises. She has a strong desire for company and is very outgoing. Homeopathic treatment started on January 7th, 2021 with *Phosphorus CH200 (individualized)* once a week for 4 weeks. *Phosphorus* was chosen because of her mental image of craving for company expansiveness and because her acute symptoms were covered by *Phosphorus*, too. On February 20th, 2021, the patient had no more complaints after 4 doses of *Phosphorus*, opposite to the time before COVID-19 infection, she could now also tolerate cold drinks. Lung auscultation was now inconspicuous, and the follow-up for 6 months was symptom-free.

### 3.3 Case 3

At the end of December 2019, a 56-year-old female patient fell ill with COVID-19. Symptoms were head flu with neuralgiform pain behind the eyes and in the forehead, loss of taste and smell, and fatigue and weakness. PCR testing of SARS-CoV-2 had become negative in December 2020. The patient's character was efficient, emotionally hard, and pragmatic; she worked a lot and was loquacious. At the beginning of the homeopathic treatment in January 2021, the patient was slightly exhausted; she could not carry out her usual leisure activities, such as mountain tours, hikes, or work. When she was exhausted, migraines, a feeling of pressure on her chest, and difficulties with breathing appeared immediately. Auscultation revealed sounds of bronchitis. On January 21st, 2021, the patient received *Gelsemium CH200* for 4 days once daily because of her neuralgiform pain in the forehead (specific) and her weakness. Since there was no improvement by January 26th, 2021, the HMP was switched to *Phosphorus CH200* (repertorized) due to lung symptoms and weakness. There was still no improvement on February 1st, 2021; therefore, she received *Influenzinum CH200* on February 4th, 2021, and *Bacillinum CH200* on February 5th, 2021. Well-prescribed remedies did not work. For this reason, the homeopath decided to use these two

nosodes en bloc before administering the next well-chosen remedy. This was a very successful strategy in the treatment of acute Covid cases. *Chininum arsenicosum CH200* started on February 6th, 2021 (specific). *Chininum arsenicosum* was chosen because the patient was weak, dull, quickly exhausted and suffered from shortness of breath when exerted with a feeling of pressure on the chest. Her inner hardness was reminiscent of *China*. *Lobelia purpurascens* might have been indicated. However, this was not known to the homeopath at that time. On February 18th, 2021, she was doing much better; her resilience was excellent, and she could now perform cross-country skiing and ski touring again. The complaints were almost gone; auscultation of the lungs did not reveal any residues of bronchitis. She received *Chininum arsenicosum CH200* twice a week for 4 weeks, then once a month for another 2 months, which permanently cured her ailments completely. Follow-ups for 6 months showed no signs of relapse. She also observed that she was less emotionally hard than before the disease (Figure 2).

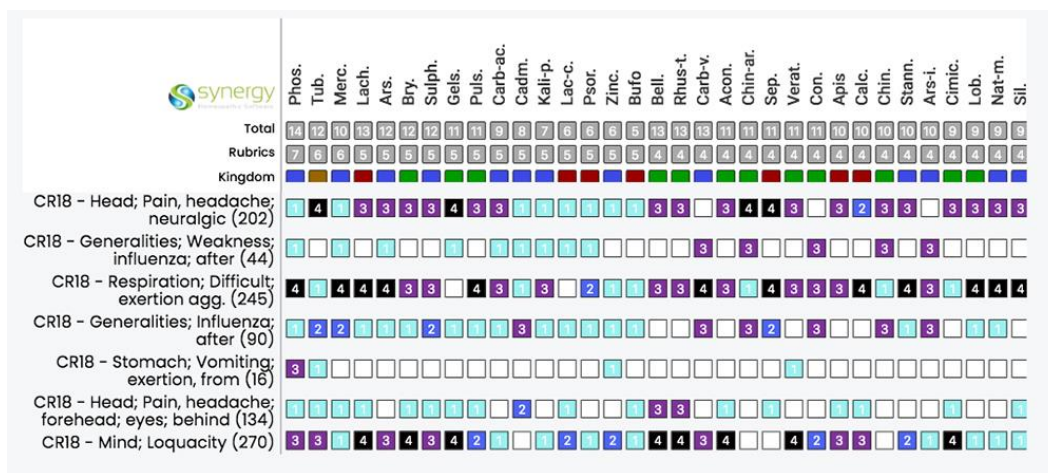


Figure 2 Repertorisation Case 3.

### 3.4 Case 4

A 33-year-old female patient fell ill with COVID-19 in January 2021. She had typical head flu symptoms, including tiredness, weakness, frontal headache, and a dry, irritating pharyngeal cough with dry rales over the lungs. At the beginning of the homeopathic treatment, the dry cough was still there, it was so bad that she could not sleep at night. The patient's constitutional HMP was *Sepia*; she was a dark, slender type with many freckles. She did not receive *Sepia CH200* on February 2nd, 2021. On February 9th, 2021, the dry cough has not improved. On February 11th, 2021, she received *Influenzinum CH200*; on February 12th, 2021, *Tuberculinum aviaire CH200* to clear the acute disease state (specific); and on February 13th, 2021, *Anas europaea* (individualized). *Anas europaea* best covers the throat symptoms with the dry cough, headaches, and flu symptoms. On February 15th, 2021 the dry cough had improved by approximately 75% and the patient could sleep through the night again. Intensity of dry rales over the lungs had decreased. She continued to receive *Anas europaea CH200* once in the evening for a further 6 days, then once a week for 4 weeks, then once a month for a further 2 months. Dry rales over the lungs decreased with each dose until complete disappearance. On February 22nd, 2021 there was only a slight urge to cough on exertion, otherwise everything was fine. Follow-up for 12 months showed no relapse of Long COVID-19 symptoms.

### 3.5 Case 5

A 42-year-old female patient suffered from COVID-19, arising January 25th until February 2nd, 2021. It was a mild course with the loss of smell and taste, a slight cold, runny nose, and temperature up to 37.5°C. On February 3rd, 2021, she returned to work, becoming increasingly tired and exhausted. Her arms and legs felt heavy as lead, she felt like she could not breathe deeply. She had a feeling of pressure that turned into panic with fear of choking. Talking about the disease helped her. Once she developed a racing heart with a sense of pressure. Otherwise, she was structured and filled in tasks, duties, and care for her husband, children and house. Now she could not do it like usual and that made her insecure and conveyed fear. On March 4th, 2021, she got *Influenzinum CH200*. On March 5th, 2021, *Tuberculinum aviaire CH200* (specific), from March 6th to 8th, 2021, *Bryonia alba CH200* (individualized). *Bryonia alba* was chosen because she was very pragmatic and did everything at home without much talking about it. Since March 10th, 2021 there was no improvement. She received *Lobelia purpurascens CH200* (individualized) 1 sip twice a day from March 11th to 15th, 2021; then until March 17, 2021, once a day. The symptoms leading to *Lobelia purpurascens* were leaden legs, tiredness, weakness and post-influenza condition. On March 17th, 2021, a significant improvement was found after a small interim low on March 12th, 2021. Everything got better and better, so *Lobelia purpurascens* was given until March 25th, 2021. At this point, the patient's energy was fully restored. She began to question her life and whether everything she was doing made sense because she was joyless about it. On March 31st, 2021, she reported that until March 26th, 2021, everything was fine, the shortness of breath and tiredness had gone away. She then went on a hike with her husband, performing at about 50% of her normal level. Afterwards, she was exhausted, and it took her 2 days to recover. She suffered from morning sickness and was now unsettled, joyless, weak, and nervous because she was afraid of not making it through the day, even though she had made it through the week well without a relapse. When repertorizing the symptoms of weakness after influenza, morning sickness on awakening, and anxiety in the morning, *Arsenicum album* and *Chininum arsenicosum* stood out. The patient was now given *Arsenicum album CH200* on April 2nd and 3rd, 2021. At the check-up on April 12th, 2021 everything had gone well except for temporary depression. She was fine until April 4th, 2021, but it had been a stressful day. She was exhausted and had not recovered. Now she was weak, tired and anxious again, with episodes of tachycardia and morning sickness. Since another dose of *Arsenicum album* had not helped, she was now on April 27th, 2021 *Influenzinum*, on April 28th, 2021, *Tuberculinum aviaire*, and on April 29th, 2021 *Chininum arsenicosum CH200* once daily until May 7th, 2021, and then once a week. Until May 17th, 2021, she was fine for 5 days, and then gradually weakened again until June 8, 2021. She, therefore, received *Chininum arsenicosum* from June 8th, 2021 for another 5 days once daily. Although everything was very good, all the old symptoms had returned since then. As there was no improvement on June 10th, 2021, she received on June 11th, 2021, *Influenzinum*, and on June 2nd, 2021, *Tuberculinum aviaire*. On June 21st, 2021, *Tuberculinum aviaire* and on June 22nd, 2021 *Phosphorus* was given again. Since there was no improvement by June 24th, 2021, the patient discontinued the therapy.

### 3.6 Case 6

A 42-year-old female patient contracted COVID-19 in December 2020. She had a fever of up to 38°C, lost her sense of taste and smell, and felt weak. After 2 weeks, she went skiing again. She



described herself as gregarious, structured, hard on herself, dark-haired and slim. Since then she has never really been healthy. She was quickly exhausted and short of breath. Her systolic blood pressure was below 100 mmHg even before COVID-19. From March 16th, 2021, she received *Tuberculinum aviaire CH200* (specific) 1 sip once a week for 4 weeks. On April 20th, 2021, everything had improved by 50%, she was fine. *Tuberculinum aviaire CH200* was now given once every 4 weeks. On June 22nd, 2021, the patient had fully recovered and was no longer in pain. She no longer suffered from hypotension. Follow-up for 10 months was without relapse.

### 3.7 Case 7

In March 2021, a 39-year-old female patient contracted COVID-19. She felt an icy coldness in her body, severe body aches, fever, and weakness. The patient was dark-haired, thin, delicate, sensitive, structured, and somewhat hard on her, and she had many freckles. Therefore, her constitutional type was *Sepia*. On May 4th, 2021, she still had severe skin freezing, tingling, and dry cough from the bifurcation with dry rales evaluated during physical examination. She kept clearing her red-colored throat and was still a bit weak. She, therefore, received her acute HMP, *Eupatorium perfoliatum CH200* (repertorized) once daily for 5 days. From May 10th to 13th, 2021, she was given *Psorinum CH200* (individualized) once daily because her skin still feels cold. On May 20th, 2021, she was doing very well. The cold feeling of the skin disappeared, and weakness and dry cough with dry rales, as evaluated during physical examination, were now completely gone; her throat was not red-colored anymore. Her constitutional HMP *Sepia CH200* was recommended to her for 2 evenings at monthly intervals for 3 months to prevent relapses. No relapse could be observed during the following 12 months (Figure 3).

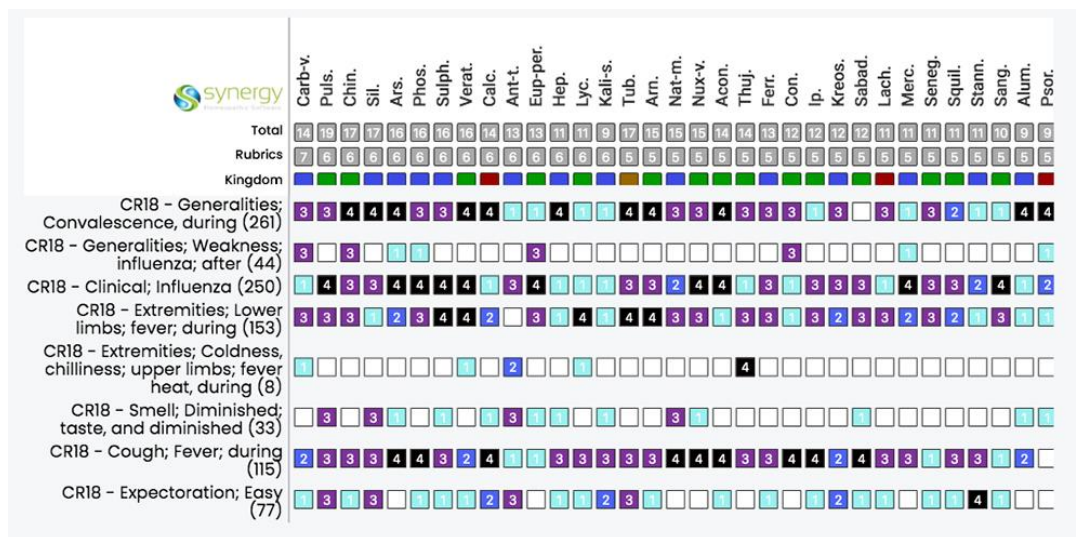


Figure 3 Repertorisation Case 7.

### 3.8 Case 8

A 41-year-old female patient received a vaccination with Comirnaty (Pfizer-Biontech, New York, NY, USA) on January 31st, 2021 and fell ill on the same day with a positive SARS-CoV-2 test: She had a frontal headache every eye movement hurt, further body aches, fever up to 37.8°C. She was extremely tired and exhausted, with trouble concentrating. In addition, she observed a left breast

swelling as in mastitis and a productive accompanying cough. After 10 days, the patient went back to work. Except for the fever and chest pain, all the symptoms had come back. Three weeks later, there was slight shortness of breath, and the sense of smell and taste were reduced. On March 9th, 2021, the following symptoms persisted: difficulty concentrating, recurring headaches every 3 days, fatigue, dizziness, and productive cough. In addition, the patient was hot-tempered; she joked and flirted with the doctor. Because of these constitutional traits, she was prescribed *Sulphur CH200* (individualized) from March 9th to 11th, 2021 once daily. The indicative symptoms were convalescence, productive cough, joking, hot temper, and shamelessness. On March 11, 2021, all symptoms came back even stronger: headache, brain fog, productive cough, red-colored throat, and tiredness. On March 13th, 2021 she received *Tuberculinum aviaire CH200* (repertorized) as an interim HMP since *Tuberculinum aviaire* can present itself similarly to Sulphur and could also be found at the forefront in the repertorization. On March 14th, 2021, she received *Gelsemium CH200* (repertorized) due to the acute symptomatology focused on the head. On March 17th, 2021, the cough was completely gone but returned following the *Gelsemium* prescription. The headaches improved a little bit, but the tiredness stayed the same. *Gelsemium* worked only partially, *Tuberculinum aviaire* worked best so far. Therefore, from March 17th to March 18th, 2021, she received *Tuberculinum aviaire* twice daily. On March 19th, 2021, the cough had completely stopped. *Tuberculinum aviaire* was reduced to once per day until March 22nd, 2021. On March 22nd, 2021, the dry cough appeared only at night. The headache was significantly less. She was so tired that she could sleep right away. She could barely stand. The symptoms would have indicated *Gelsemium* but did not eliminate the general tiredness and the paralytic condition. Both HMPs worked only symptomatically, but did not cover the overall condition. *Lobelia purpurascens* (specific) is very similar to *Gelsemium*, which is mentioned in the rubric “weakness of legs after influenza”. Therefore, on March 22nd, 2021, she was given *Lobelia purpurascens CH200*, 1 sip twice a day until March 25th, 2021. By that time, the weakness was wholly gone, as was the headache. *Lobelia purpurascens* was now given once in the evening 1 sip every week for 4 weeks, then once monthly for 2 months. In a follow-up on June 4th, 2021, she reported that by mid-May, she was fully recovered and had stopped taking it. The cough and the red-colored throat had completely vanished. Since then, she had been healthy again. The patient remained symptom-free during follow-ups for 13 months (Figure 4).

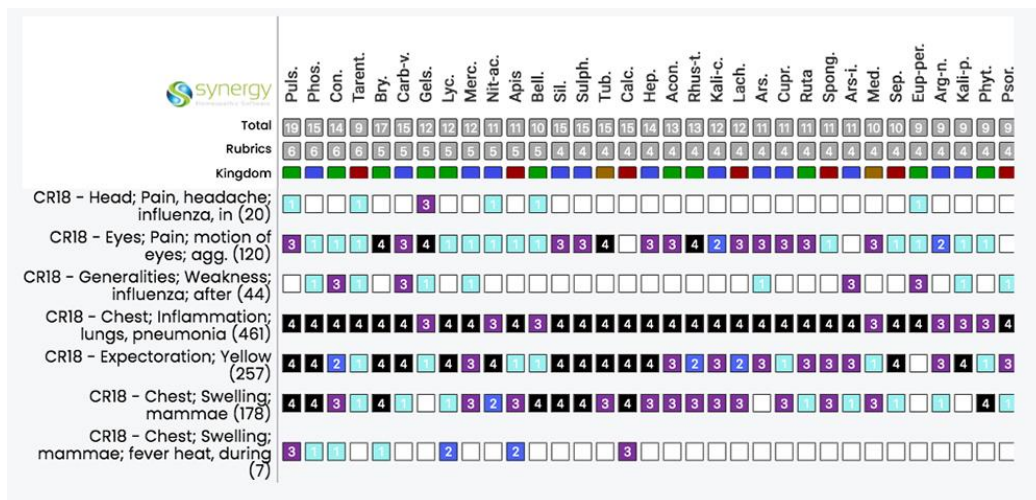


Figure 4 Repertorisation Case 8.

### 3.9 Case 9

A 76-year-old female patient presented with arterial hypertension, coronary syndrome, and heart failure in her medical history. She was tested positive for SARS-CoV-2 on March 9th, 2021. The disease was severe, with fever, dry cough, hacking cough, weakness, and reduced oxygen saturation. On March 16th, 2021, she was admitted to the ICU for 14 days because of pneumonia and a dry cough. Her mood was very positive. She was not very communicative, although she was otherwise very talkative. After the stay at the ICU, she was transferred to the internal regular ward for 3 weeks because of problems with arterial oxygenation and a dry cough. Now, she was alone at home. Her mood became very hostile. She thought she had no much longer to live and questioned the meaning of her life. She started to talk again with her neighbors, and the hacking cough lessened, but she was physically weak and presented difficulty breathing when walking; oxygen saturation was between 90 and 92%. She was traditional and down to earth. She was a farmer and had a big problem with young farmers. She was competitive and comparative. At the start of treatment on May 3rd, 2021, *Bryonia alba* CH200 (specific), 1 sip twice daily for 2 evenings, was prescribed. *Bryonia alba* was the HMP that suited her acute symptoms such as her negative mood and hacking cough. On May 6th, 2021, she produced large quantities of urine, so *Bryonia alba* was stopped on May 7th, 2021. It was now apparent that she was very traditional, joking, strict, and suspicious. On May 14th, 2021, she got *Kalium bichromicum* CH200 (individualized), 5 globules every 14 days, then once a month from mid-June. On May 19th, 2021, the patient was significantly better. She was able to walk normally again on the flat, she could not yet make it uphill; oxygen saturation improved to 93%. On June 21st, 2021, she appeared much better. She could walk up and get enough air; oxygen saturation was now beyond 95%. She also received *Kalium bichromicum* CH200 monthly for 3 months. Follow-ups for 12 months revealed no relapse.

### 3.10 Case 10

A 51-year-old female patient had no previous illnesses. In March 2021, she fell ill with COVID-19, displaying loss of taste, dry hacking cough, and slight fever, and she felt like she had the flu. A week after her recovery, as confirmed by negative SARS-CoV2 testing on May 22nd, 2021, she had developed LongCOVID-19 syndrome. She was tired, dizzy, unable to work under pressure, and exhibited supraventricular tachycardia from time to time. In general, even before COVID-19, she was hot-tempered and restless, with the improvement of her condition by movement, and she was interested in many things. Homeopathic therapy started on May 27th, 2021. The acute COVID-19 symptoms pointed to *Anas indica* (specific), which she received as CH200 in water, 1 sip once daily. She was better at the follow-up on May 31st, 2021, so *Anas indica* continued. On June 7th, 2021, fatigue had improved by 25%. She felt very exhausted after work, restless, and woke up at 5 a.m. Due to her constitutional characteristics and supported by indication as a convalescent HMP, a change was made to *Sulphur* CH200, 1 sip once daily. At the control on June 15th, 2021, all complaints were better for about 10%. She was worried about her only sister with three children, one of whom was diagnosed with attention deficit hyperactivity syndrome (ADHS). The patient supported her sister daily, but her energy was not reasonably sufficient. She still woke up at 5 a.m. every day, while brooding, getting nervous, anxious, and unable to fall asleep again. Repertorization clearly indicated *Arsenicum album*. Therefore, from June 15th, 2021, until June 24th, 2021, she received *Arsenicum album* CH30 in water, one sip once in the evening. On June

24th, 2021, the patient was more relaxed and could sleep better. Only her energy level was unsatisfying. From June 24th, 2021, she was now prescribed *Arsenicum album CH200*, one sip once a night for three nights, then once a week for 4 weeks, then once a month for another 2 months. From June 26th, no more supraventricular tachycardia was observed; 24-hour ECG was inconspicuous. Furthermore, she now described herself as less hot-tempered and less restless. On July 15th, 2021, she was much more stable and reported a better energy level. Due to her living situation, she was still much stressed. On July 20th, 2021, she was utterly physically fit again, mostly sleeping well without waking up. She now felt and remained completely healthy, as observed during follow-ups for 12 months (Figure 5 and Figure 6).

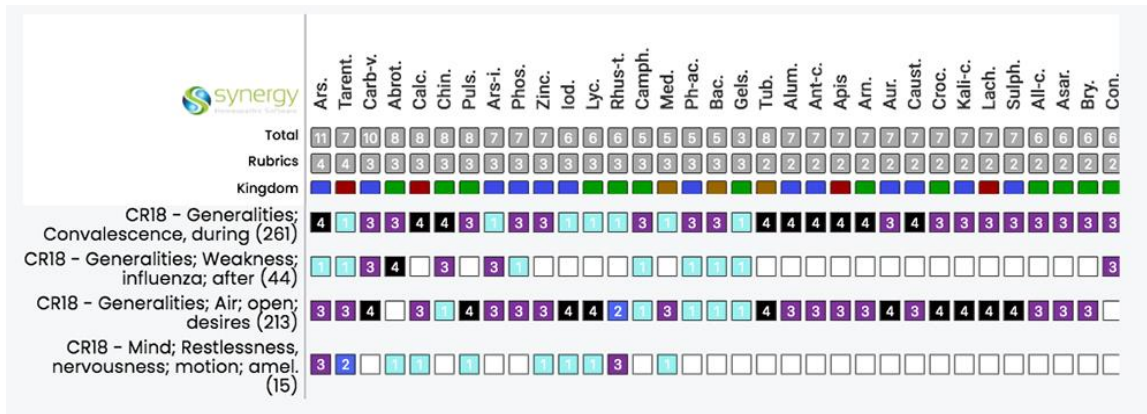


Figure 5 Repertorisation Case 10a.

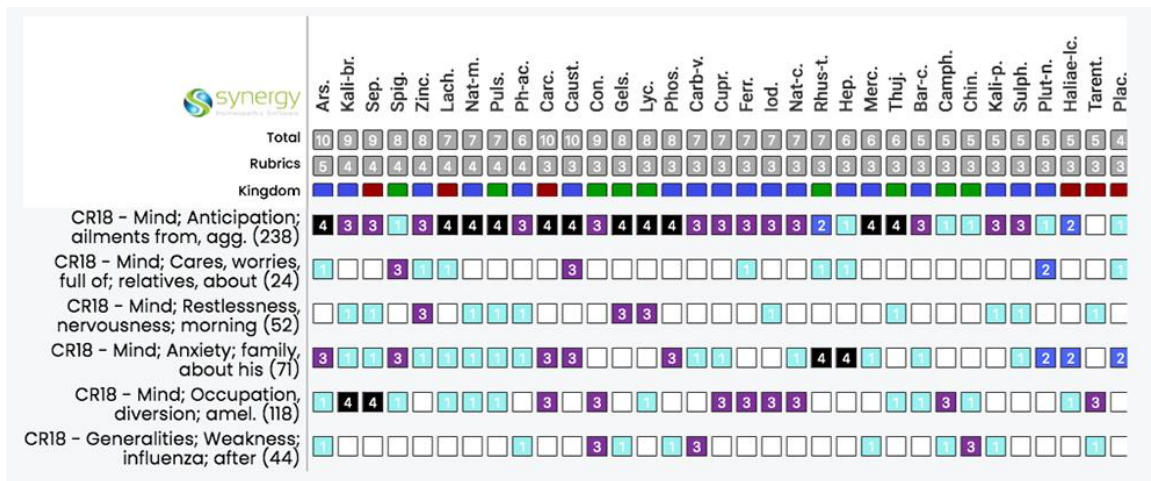


Figure 6 Repertorisation Case 10b.

### 3.11 Case 11

A 48-year-old female patient suffered from COVID-19 with body aches and joint pains in winter 2021. The same symptoms had reappeared without recreation time after the first COVID-19 vaccination. She, therefore, received *Eupatorium perfoliatum 30CH* (specific) once a day, one sip for one week on May 25th, 2021. At the follow-up on July 12th, 2021, the patient reported that the HMP had helped very well; the body aches and joint pains had disappeared. Rheumatologic examination by an orthopedic was now inconspicuous. After the second vaccination, the patient suffered from repeated headaches. Again, *Eupatorium perfoliatum CH30* was prescribed once

daily 1 sip for 1 week. At the subsequent follow-ups for 9 months, the complaints had disappeared entirely.

### **3.12 Case 12**

In January 2021, a 74-year-old female patient experienced a COVID-19 infection with a dry cough, viral pneumonia and extreme weakness. The sister was treated in the hospital with comparable symptoms and died in the ICU. Residues of pneumonia were still present as shown by chest X-ray. Two months later, severe hair loss started. Hair loss 2 to 3 months after a serious illness is not specific to COVID-19, but after all the grieving for the sister and going through the illness, homeopathic treatment was initiated. She was a communicative person. The acute symptoms of the disease spoke clearly for *Phosphorus* (specific), her distress for *Natrum muriaticum*. On April 21th, 2021, the patient received *Phosphorus CH200*, 5 globules, during 2 evenings. In addition, she took nutritional supplements and a hair shampoo containing caffeine. The hair started to grow again at the follow-up on May 27th, 2021. She reported being balanced, and mentally, she was doing much better. Chest X-ray showed no more signs of pneumonia. To prevent recurrence and to deal with the grief of losing her sister, *Natrium muriaticum CH200* (individualized) was prescribed for 2 consecutive evenings on May 27th, which significantly improved her mental condition as described by her relatives. She remained symptom-free during the follow-ups for 10 months.

### **3.13 Case 13**

A 51-year-old female patient had COVID-19 disease on April 29th, 2021. The PCR- test was positive. There was extreme muscle and joint pain and fever up to 39°C, the patient was listless and felt tired. She also noticed loss of taste and smell. On April 24th, 2021, she had received her first vaccination. On June 22, 2021 she was still limp and tired. There was also weight loss, muscle wasting and shoulder pain. The cause of the shoulder pain was activated arthrosis, which had become active again since the illness. The symptoms of the acute illness were indicative of *Eupatorium perfoliatum* (specific), which she received as CH200 in water, one sip in the evening on June 22th, 2021 for 3 to 5 days. At the follow-up on June 29th, 2021, she was significantly better. She no longer had to lie down and rest in the middle of the day. She regained her appetite and weight, and the shoulder pain was gone. Orthopedic control confirmed a significant improvement in shoulder arthrosis. At the follow-up on July 15th, 2021, all complaints were improved by 70%. She had only had a depressive phase once during the treatment. She was now prescribed *Eupatorium perfoliatum CH200* in water, one sip once a week until the end of July, then once a month for 2 months. At a follow-up on July 30th she was symptom-free as observed for 10 months.

### **3.14 Case 14**

A 52-year-old female patient contracted COVID-19 from April 6th, 2021 until April 13th, 2021, as had her entire family. She had a fever of up to 38.5°C, joint pains, and an oppressive headache over the front of the eye. She was very limp with a slight feeling of pressure on her chest as if she could not breathe deeply. The taste and smell were gone. She had not fully recovered since and

continued to be tired and listless, and she could hardly do her housework. She suffered from shortness of breath on exertion and occasional palpitations at night. Lung function showed restriction. Before COVID-19, the patient's character was down-to-earth, friendly, hot-tempered, always on the move, and always had something to do. Even when she was ill, she needed company. Homeopathic treatment started on June 30th, 2021, with *Lobelia purpurascens* CH200 (specific) in water in the evening 1 sip daily for 1 week. *Lobelia purpurascens* was chosen because the acute symptoms were similar to *Gelsemium* but with additional lung involvement. This is typical of *Lobelia purpurascens*. Follow-up on July 14th, 2021: The symptoms were improved by 50%, and the feeling of pressure on the chest was almost gone and only came up very rarely. The chest X-ray was unremarkable except for old cicatricial residues, and the lung function improved (78%). Her personal normal value was 82%. *Lobelia purpurascens* CH200 was continued once daily. Since on July 27th, 2021 no further improvement could be found, and shortness of breath became more frequent again, she received *Sulphur* CH200 (repertorized) in water once in the evening for 5 days. *Sulphur* was chosen because of its versatility. It is typical for patients to always be on the move, hot-tempered, and chaotic in communicating with the homeopath, as well as being a convalescent HMP. Constitutional characteristics and symptoms of her Long-COVID-19 disease were in accordance with the HMP. On August 10th, 2021, the patient sent a SMS stating that the last globules worked very well. Yesterday and tonight she took them again and then 1 week off. She was now prescribed *Sulphur* CH200 in water once in the evening 1 sip once a week for 4 weeks, then once a month for 2 months. On November 4th, 2021, she said that she was almost 100% better, fully resilient and rarely used her asthma spray. *Sulphur* was taken once a week until mid-October, now once a month from mid-November. In February 2022 she reported an occasional dry cough. *Sulphur* 1M was administered thrice, and from mid-March, *Aspidosperma quebracho blanco* C12 (specific) was added twice a week. *Aspidosperma quebracho blanco* was administered as an organ-specific HMP to treat the cicatricial residues described in the chest X-ray. On May 12th, 2022, the patient reported that she had calmed down, was less hot-tempered and restless, less agitated, and could now structure her everyday life with the children better. Chest X-ray was now without cicatricial residues. The shortness of breath on exertion had disappeared entirely; the asthma spray was no longer used. No relapse could be observed during the next 10 months (Figure 7).

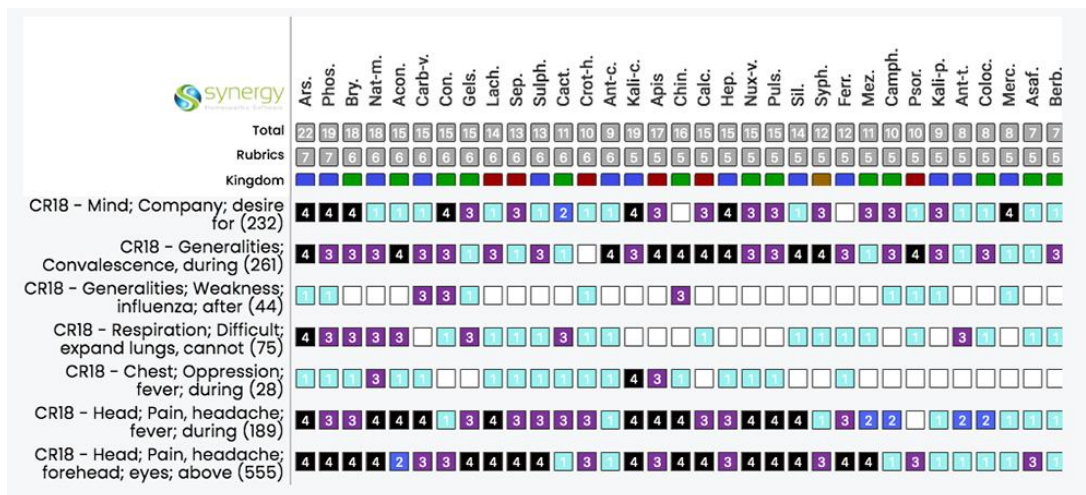


Figure 7 Repertorisation Case 14.

### 3.15 Case 15

A 57-year-old patient had no known previous serious physical illnesses; she had been suffering from depressive moods since her brother's death. On November 16th, 2021, she reported that she had had a fever of up to 38°C for three days, lumbar pain, and diarrhea once. These symptoms were accompanied by a dry, bronchial, painful cough without shortness of breath. She was also grumpy and taciturn and suffered from extreme weakness. The PCR for SARS-CoV-2 was positive. The patient now received *Bryonia alba* CH200 (individualized), one sip three times a day from November 16th until November 18th. Since there was no improvement, she received now on November 19th *Influenzinum* CH200 (specific) one sip three times a day, then from November 20th *Tuberculinum Koch* CH200 (specific) in the exact dosage. From November 22th, she noticed that the cough was easing, the weakness was unchanged, and she was a little anxious after coughing attacks because of a slight shortness of breath. The physical weakness felt worse, and the cough was wet and deep-seated. She was then given the *Arsenicum album* CH200 (individualized), one sip thrice daily.

On November 24th, the patient was better. She still felt weak and hardly had any cough. Some episodes of palpitations, which she had previously had, occurred. *Arsenicum album* CH200 was taken once a day, one sip until November 29th. The patient reported that everything had improved by about 60%. From time to time, she had a slight dry cough and was physically weak but showed no shortness of breath and no fever anymore. She was shivering but otherwise feeling fine. She was now prescribed *Psorinum* CH200 (specific), one sip three times a day. From December 2nd, the patient was healthy but still convalescent. A bloated abdomen was a new occurrence. She now received *Psorinum* CH200, 5 globules in the evening once a week. At the follow-up on December 9th, the abdomen continued to be distended. The patient felt very weak and sometimes dizzy.

She was therefore given *Carbo vegetabilis* CH200 (individualized), one sip once a week for 4 weeks. On January 5th, 2022, she reported that all symptoms had disappeared except for panic attacks that made her think she was going to die. The follow-up on January 10th, 2022 showed that the panic attacks had increased: everything in the chest contracted, but without heart symptoms, and she was afraid of dying with tingling skin. These panic attacks first occurred four years ago when her brother died of lung cancer. At that time, the patient had had to organize a lot over several months. Usually, she didn't talk about these things. She was now given *Natrum muriaticum* CH200 (individualized), 5 granules twice a day for three days, then *Avena sativa* CH6, 5 granules twice a day for 2 days. On January 18th., the panic attacks went away completely, but the bloated stomach and flatulence came back. She was then given *Psorinum* CH200 in water, one sip twice a day, for a week. Since the intestinal symptoms remained unchanged, sometimes accompanied by slight weakness, she got one *Sulphur* CH200 (specific) sip on January 25th.

Follow-up on February 1st: Symptoms came on suddenly, including bloating abdomen, cramping pains, and belching, while the wind was relieved. This was accompanied by fainting spells and pulling and burning sensations in the chest without shortness of breath. In addition, there were nervousness, anxiety and despair at recovery. Therefore, *Carbo vegetabilis* CH200 (individualized) was given once on February 2nd. On February 15th it was much better; physical examination showed no abdominal pain anymore, but the patient sometimes tended to exhibit a panic attack. Since energy and digestion had improved, the HMP was given every 4 weeks.

Follow-up August 16, 2022: The last intake was at the end of April 2022. Since then there have been no relapses, the disease can be considered cured.

### **3.16 Comments on Patient Histories Describing Decisions and Limitations**

Comment on Case 3: Since no improvement could be achieved due to two well-chosen HMPs and her symptoms could not be further specified, a combination of HMPs most closely corresponds to the COVID-19 disease was chosen. The combination contained *Influenzinum* (weakness, body aches, headaches, bronchial symptoms), and *Bacillinum* (the HMP is obtained from a tuberculosis cavern and covers both a mitigated lung problem and additional superinfections). This certain kind of HMPs, called nosodes, also increase the effect of other well-chosen HMPs. *Chininum arsenicosum* was chosen because the patient exhibited constitutional symptoms of *China*. The repertorisation reveals *Arsenicum album* at the forefront and also *Chininum arsenicosum* at 12<sup>th</sup> place. *Chininum arsenicosum* is known for weakness, shortness of breath, and a feeling of pressure after influenza.

Comment on Case 5: No lasting improvement could be achieved. Paradoxical reactions and deteriorations occurred that could not be explained. The patient was then offered constitutional treatment, since essential constitutional aspects were probably overlooked in the prescriptions. The patient refused this. It was only temporarily improved but not cured. From this casuistry, it can be clearly deduced that too frequent administration of medication can lead to lasting deterioration. In the case of long-term COVID-19 diseases with pronounced weakness, the author switched to diluting the homeopathic medicine in water and just taking a sip of it, and no further paradoxical reactions were shown with this mode of administration. Of course, one might consider that other HMPs might have been used.

Comment on Case 6: *Tuberculinum aviaire* was chosen because it covers severe weakness and non-specific bronchial symptoms that lead to one of the tuberculins. *Tuberculinum aviaire* is the indicated tuberculosis nosode in states of weakness after viral diseases.

Comment on Case 8: The patient had moderate to severe LongCOVID-19. The case history clearly shows how purely symptomatic therapy sometimes has a suppressing effect but does not cover the overall condition. Only the right choice of the individually best-fitting HMP (*simile*) leads to lasting health.

Comment on case 9: *Kalium bichromicum* met the patient's constitution and matched the focus on her lungs. *Kalium bichromicum* is more communicative than *Kalium carbonicum*, and *Kalium sulphuricum* would have been considered an alternative if *Kalium bichromicum* had failed. This case report was about a severe COVID-19 illness with an equally severe -Long COVID-19 after recovery. The therapy responded surprisingly well, considering the patient's advanced age.

Comment on Case 10: The patient showed moderate Long-COVID-19 syndrome with physical weakness. Prescribing an HMP based on the acute symptoms brought improvement. However, no cure. Only after recording the patient's life situation was an HMP found to bring lasting health. *Arsenicum album* is an HMP for restlessness and nervousness at night in patients who are very worried about their loved ones. The patient's pronounced weakness is also a key symptom of *Arsenicum album*, which appears to be one of the main HMPs in the COVID-19 pandemic and has often been indicated in the delta variant of SARS-CoV-2, which this patient had suffered from.



Comment on Case 11 and Case 13: Both Case 11 and Case 13 underline that acute HMP can heal persistent symptoms, especially in cases where specific causes of Long-COVID-19 syndrome can be identified.

Comment on Case 14: It was a moderate to severe Long-COVID-19 syndrome. In this case, *Sulphur* served not only as a convalescent HMP but also as a constitutional HMP that improved her chronic bronchial asthma, as confirmed by lung function tests.

Comment on Case 15: *Sulphur* and *Psorinum* hadn't worked sufficiently, repertorisation clearly pointed to *Carbo vegetabilis* and helped throughout the disease. *Carbo vegetabilis* had been discontinued because it could have intensified the old psychological trauma. Since the other HMPs had not helped, this led to the conclusion that *Carbo vegetabilis* had been administered a little too often in a short period of time. Overall, the patient had a moderately severe COVID-19 infection with subsequent Long COVID-19 syndrome, which was cured by homeopathic treatment.

### 3.17 Collective Assessment

Fifteen female patients with Long-COVID-19 symptoms were admitted and treated by individualized homeopathy. All patients were older than 18, with a mean age of  $48.5 \pm 13.5$  (SD) years. All patients were treated with additional HMPs and except one (patient no. 5), hence 93.3% were healed from Long-COVID-19. In the 14 healed patients, a time-dependent improvement of relevant clinical symptoms could be observed. The average time until improvement/remission was  $47.6 \pm 34.6$  days. The median was 37 days.

### 3.18 Naranjo Assessment

The additional modified Naranjo assessment (Table 1) as part of the HOM-CASE-CARE guidelines revealed either +8 or +9 points in 14 patients (93,3%), except for Case 5, with a score of 0.

**Table 1** Modified Naranjo Criteria for Homeopathy-Causal Attribution Inventory [10] for the 15 patients.

Pat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	+2	+2	+2	+2	0	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2
2	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	+1	+1	+1	0	+1	0	0	0	+1	0	0	0	+1	0
5	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
6 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
9	+2	+2	+2	+2	0	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2
10	+1	+1	+1	+1	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Total	+8	+9	+9	+9	0	+9	+8	+8	+8	+9	+8	+8	+8	+9	+8

Pat.: Patient Case Number; Total: Total Score

### **3.19 Adverse Events**

All patients were asked for adverse events according to Common Terminology Criteria for Adverse Events (CTCAE) during each follow-up [14]. In addition, patients were encouraged to report suggested adverse events, initial aggravations, the occurrence of old or new symptoms, etc., immediately to the homeopathic physician. No adverse events attributable to the homeopathic treatment were reported.

## **4. Discussion**

While at the beginning of the pandemic, medical professionals were busy caring for hospitalized patients, and non-hospitalized sufferers took to social media to complain of ongoing symptoms, dubbed "Long-COVID-19" [15]. Temporal courses were also defined, with each symptom lasting more than four weeks being described as "Long-COVID-19" [16]. Furthermore, the "post-COVID syndrome" was defined as complaints over three months.

A recent paper describes that after screening almost 4,500 articles and meta-analyzing 41 included studies, global pooled post-COVID-19 condition prevalence is estimated to be 0.43 (95% CI: 0.39, 0.46), with those hospitalized experiencing a higher prevalence of 0.54 than those not hospitalized of 0.34 [17]. 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. Fatigue was the most common symptom reported with a prevalence of 0.23 (95% CI: 0.17, 0.30), followed by memory problems (0.14 [95% CI: 0.10, 0.19]) [17]. Patients with Long-COVID-19 often report fatigue, performance limitations, headaches, smell and taste disorders, coughing, insomnia, depressive moods, anxiety symptoms, cognitive impairments, hair loss, and stress. In most of the COVID-19 cases observed, there are residual conditions of the acute disease that respond very well to the acute homeopathic medication indicated at the time of the acute symptoms. In rarer cases, the symptoms of Long-COVID-19 only develop afterward. This is especially true for relatively mild courses with few symptoms, in which chronic symptoms gradually develop a few weeks after recovery. In still other cases, a chronic disease, that has existed for a long time, flares up.

Many patients with Long-COVID-19 have come to the homeopathic practice for the first time without any previous constitutional homeopathic anamnesis. Except for a few cases, it was unnecessary to catch up on this to treat the patients successfully.

Mechanisms of development of the post-infectious symptoms in LongCOVID-19 patients are unclear, so no specific therapy can be carried out. Various hypotheses show a large heterogeneity [18]. Long-lasting, low-grade inflammation or autoimmunity is discussed, and residual virus fragments that can be detected in the intestine for seven months are also possible [19]. Zollner et al. investigated whether SARS-CoV-2 antigen persistence underlies the post-acute COVID-19 syndrome [19]. The authors performed an endoscopy study with 46 inflammatory bowel disease patients 219 days (range: 94-257) after a confirmed COVID-19 infection. SARS-CoV-2 antigen persistence was assessed in the small and large intestines by qPCR of four viral transcripts, immunofluorescence of viral nucleocapsid, and virus cultivation from biopsy tissue. Viral nucleocapsid protein persisted in 24 of 46 patients (52.2%) in gut epithelium and CD8+ T cells. Expression of SARS-CoV-2 antigens was not detectable in stool, and viral antigen persistence was unrelated to severity of acute COVID-19, immunosuppressive therapy, and gut inflammation.

Post-acute sequelae of COVID-19 were reported from the majority of patients with viral antigen persistence but not from patients without viral antigen persistence. Their study indicates that SARS-CoV-2 antigen persistence in infected tissues serves as a basis for post-acute COVID-19 [19].

An altered type I interferon response and the reactivation of different viruses such as herpes viruses/EBV and microvascular dysfunctions, have also been described [20]. Mental stress is considered to be an important factor in immunological mechanisms [21]. It is possible that a subgroup has functional  $\beta$ -adrenergic antibodies and could benefit from immune adsorption, analogous to initial observations in chronic fatigue syndrome [22]. Unfortunately, there are no studies on this, so this therapy cannot be offered now. The role of mitochondrial dysfunction [23, 24] and other mechanisms have also been discussed [25].

In a national, cross-sectional study carried out in Denmark, which included SARS-CoV-2-positive adolescents suffering from Long-COVID-19 and matched controls, participants with SARS-CoV-2-positive tests had more long-lasting symptoms and sick leave. In contrast, participants in the control group had more short-lasting symptoms and worse quality of life [26].

Initial data show that post-COVID symptoms adversely interfere with oncology treatment goals [27, 28]. Since homeopathy is able to improve life quality and life expectancy, a synergistic effect regarding Long-COVID-19 and cancer symptoms might be achieved [29-31]. Complex clinical pictures such as Long-COVID-19 are best treated in an interdisciplinary manner. In the event of certain symptoms, it is therefore advisable to consult colleagues from the respective specialty in order to ensure optimal patient care. This is because other differential diagnoses must also be taken into account. In addition, a specialized clarification is necessary for restrictions that last longer than three months. Fortunately, even patients with severe lung involvement can recover completely. However, reliable conventional therapeutic interventions are not known. Therefore, homeopathy as a comprehensive method is worth considering in all cases, including Long COVID-19 and COVID-19 [32-35].

A major limitation is the assessment of the patients. However, it is almost impossible outside of a university-based institution to perform prospective, double-masked, placebo-controlled studies. Furthermore, no male patients were included. This reflects the often observed situation in most medical offices, including complementary medicine, where female patients are predominately seeking medical advice. In the experience of most physicians, male patients are more often reluctant to make an appointment for medical treatment.

A further limitation is that we have not used questionnaires. Such questionnaires do not convey a diagnosis but offer first indications for further exploration [36]. In doing so, one must consider that shorter questionnaires are less accurate than longer ones. The basis of the diagnosis is still the medical discussion.

## **5. Conclusions**

In conclusion, additive classical homeopathy may help treat patients with confirmed Long-COVID-19 syndrome. Recently, a book chapter has been published on the integrative homeopathic therapy against viral epidemics with focus on COVID-19 [37]. Individualized homeopathic treatment, as described in our case series, or the combination of conventional medicine and homeopathy in Long-COVID-19 patients, seems to be a promising way forward in

integrative medicine to optimize patient treatment. Further prospective, randomized, double-blind, placebo-controlled studies are warranted.

## **Acknowledgments**

We thank Dr. Hedda Sützl-Klein, European Society for Integrative Health Research, for encouraging publication as well as for valuable discussion of the manuscript.

## **Author Contributions**

Michael Takacs: Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing, Project administration. Michael Frass: Conceptualization, Investigation, Data curation, Writing – original draft, Writing – review & editing, Supervision. Anja Pohl-Schickinger: Writing – original draft, Writing – review & editing, Supervision. Philippa Fibert: Methodology, Writing – review & editing, Supervision. Peter Lechleitner: Validation. Menachem Oberbaum: Validation, Writing – original draft, Supervision. Ilse Leisser: Resources. Peter Panhofer: Investigation, Writing – original draft. Kavita Chandak: Methodology, Writing – review & editing. Petra Weiermayer: Conceptualization, Writing – original draft, Writing – review & editing, Supervision.

## **Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## **Conflicts of Interest**

The authors declare that they have no conflicts of interest.

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