



Early View

Research letter

COVID-19 follow-up programs across Europe: an ERS END-COVID CRC survey

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Title

COVID-19 follow-up programs across Europe: an ERS END-COVID CRC survey

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Text

SARS-CoV-2 is responsible for a multi-organ syndrome that can last over 12 months after the initial infection, including pulmonary and systemic consequences with residual radiological or functional alterations [1–3]. According to international guidelines, post-COVID-19 syndrome or condition is defined by a variety of signs and symptoms occurring during or after an infection consistent with COVID-19, lasting for more than 8-12 weeks and not explained by an alternative diagnosis [4, 5]. Main symptoms are fatigue, dyspnea, arthralgia, chest pain, cough and neurocognitive impairment [6]. Approximately one third of patients reported an impaired quality of life 3 months after a COVID-19 diagnosis [7]. Given the wide range of symptoms and severity reported, no set of investigations and tests seems to be suitable for everyone and the optimal follow-up after severe COVID-19 infection is still unclear, with scarce data published on this topic [4, 8, 9]. Furthermore, criteria for patients' inclusion in COVID-19 follow-up programs and standard operating procedures (SOPs) including imaging and functional assessment, telemedicine availability and characterization of the involved multidisciplinary teams across Europe are unknown. Based on published reports it can be expected that approaches to follow-up will be heterogenous among European countries [10].

In order to address this topic, a survey about COVID-19 follow-up programs was conducted by the European respiratory Network for Data sharing on COVID-19 (END-COVID) Clinical Research Collaboration. The survey was designed to explore the heterogeneity of COVID-19 follow-up programs across Europe and included 31 questions about the general organization of programs, patients' inclusion criteria, telemedicine availability and characteristics of follow-up visits

(<https://ers.app.box.com/s/rkwf44vfcrp7s10992ve0043llukg135>). The survey was sent *via* email to the END-COVID academic stakeholders (including representatives named in every ERS assembly and representatives of national or local COVID registries), to the European Respiratory Society (ERS) assembly on Interstitial Lung Disease (ILD) and to every ERS member having highlighted an interest in participating to data collection. Only one reply from each center was allowed.

Responses until September 2021 were collected from 130 centers across 26 European countries. The majority of the respondents were pulmonologists (90.8%), either general respiratory physicians (57.7%) or ILD specialists (33.1%). Other respondents were radiologists, nurses, internists, infectious diseases specialists, thoracic surgeons, clinical researchers and intensivists. 79.2% of centers were university hospitals, 13.8% regional hospitals, 6.2% private clinics and 0.8% outpatient clinics. COVID-19 follow-up programs were managed by a dedicated clinical unit in 66.9% of the cases and the majority of those belonged to the pulmonary department. Follow-up programs incorporated a multidisciplinary team in 81.6% of the centers, with the most frequently involved healthcare professionals being physiotherapists (84.6%), nurses (63.1%), psychologists/psychiatrists (46.2%), dieticians (27.7%), infectious disease specialists (15.4%), cardiologists (15.4%) and neurologists (10.8%). Only in one center a general practitioner (GP) was incorporated. 43.4% of centers included only patients after hospitalization and 56.6% included both previously hospitalized patients and ambulatory patients with persistent symptoms. The most commonly used criteria to include patients in the follow-up programs were the need for oxygen therapy at hospital discharge (88.5%), the need for mechanical ventilation during hospitalization (87.2%), ICU admission (85.9%) and severe, persistent post-COVID-19 symptoms (64.1%). Telemedicine was available in 30.3% of the centers, consisting of symptoms assessment, review of tests requested at discharge and request of further control tests according to symptomatic evaluation. The most used tools evaluated during telemonitoring were pulmonary

functions tests (PFTs), including spirometry and diffusing capacity of the lung for carbon monoxide (DLCO), chest high resolution CT scan (HRCT), chest X-ray (CXR), blood tests and quality of life questionnaires. Timing for follow-up visits through telemedicine across different centers ranged between two weeks and three months after hospital discharge. Timing for face-to-face follow-up visits ranged between one month and six months after hospital discharge: 40.3% at one month, 13.9% at two months and 37.5% at three months. During the first face-to-face visit the presence of dyspnea was investigated in 94.4% of the programs (mainly using the MRC scale), while cough was evaluated in 50.7% (mainly through the Leicester cough questionnaire). Both imaging and functional assessment were part of the workup, as they were performed regularly in most centers (95.5% and 79.1%, respectively). In terms of imaging evaluation, 37.5% of centers stated to use CXR alone, 39.1% HRCT alone and 18.8% both CXR and HRCT, while 3.1% were using low-dose CT scan. In terms of functional evaluation, 90.6% of centers reported they used both spirometry and DLCO, and 9.4% used spirometry alone, while 6 minutes walking test was routinely performed in 71.7% of the centers. An integrated rehabilitation program was available in 68.7% of the centers, either on-site or domiciliary. Psychological support was routinely offered in 63.3% of centers, mainly referring to psychologists/psychiatrists or physiotherapists. Follow-up visits were part of the SOPs for 98.3% of centers with a different timing, ranging from 1 to 12 months after the initial evaluation (more commonly after 3 months). Both assessment of dyspnea and imaging evaluation, including CT scan, were part of follow-up programs in 93.1% and 86.2% of centers, respectively. A specific ILD consultation in case of persistent CT scan alterations was organized in 84.0% of the centers, while additional PFTs during follow-up were organized in 94.8% of the centers, either at every evaluation or every 3-6 months, according to patients' characteristics. Large differences in the management of post-COVID-19 syndrome have been detected among European countries, especially in terms of the presence of multidisciplinary teams (from 0 to 100%), telemedicine

availability (from 0 to 43%), rehabilitation availability (from 0 to 100%) and first follow-up visit timing (from 1 to 6 months), see figure 1. Moreover, a wide heterogeneity was detected across Europe in terms of criteria for patients' inclusion in follow-up programs as well as for imaging and functional evaluations.

According to our findings, a higher number of HRCT and PFTs are routinely performed in European countries than what is suggested by international guidelines [4]. Although a multidisciplinary team was part of most of the COVID-19 follow-up programs, only one center had a GP included in the team, hinting at a possible lack of integration between hospital and community management of patients. Psychological support is offered, when needed, in almost two third of centers, as depression and anxiety are very common even six months after the acute infection [11]. Although important changes in telemedicine availability appeared during COVID-19 pandemic, our data showed that telemedicine is part of COVID-19 follow-up programs in less than one third of centers [12]. The heterogeneity in SOPs across different countries we found in our experience should be interpreted as a reasonable response to Post-COVID-19 syndrome in view of the dissimilar temporal incidence of COVID-19 outbreaks, various epidemiology of SARS-CoV2 variants, populations' characteristics and healthcare systems structures. This is the first European survey on COVID-19 follow-up programs with data from 130 centers across 26 countries, exploring several aspects of disease management. However, the majority of the respondents were pulmonologists and a limitation of our study include lack of information about COVID-19 follow-up programs managed by other health care professionals, such as internal medicine or infectious disease specialists. Furthermore, most of the responses were from university hospitals and more than 50% of centers were based in Italy, Greece, Spain, UK and France. Moreover, almost one third of centers had a special focus on ILD, which might have led to an overestimation in our survey of the use of radiology, and particularly HRCT. Finally, another limitation is that our study ended in

September 2021 and we can speculate that new follow-up programs have emerged in different countries since then. We were not able to detect these changes and a follow-up of this study is planned in the upcoming years.

In conclusion, post-COVID-19 syndrome and lung sequelae represent a relevant burden on European healthcare systems. In order to include different health systems in the implementation of European interventional trials and to facilitate research on post-COVID-19 syndrome, a homogeneous approach to SOPs could be considered.

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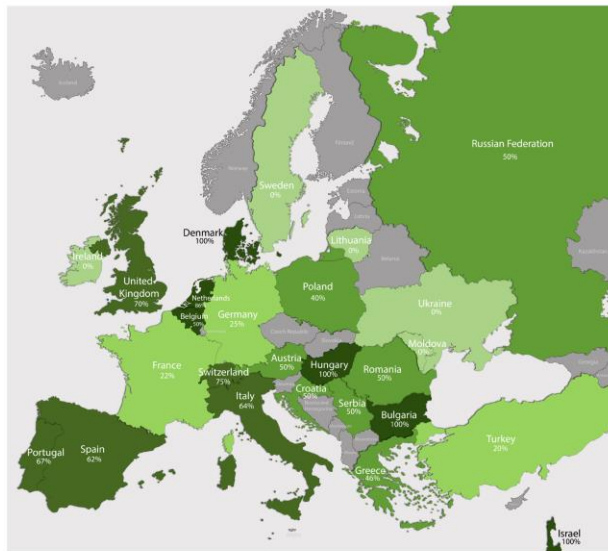
References

1. Huang L, Yao Q, Gu X et al. 1-year outcomes in hospital survivors with COVID-19: a longitudinal cohort study. *Lancet* 2021; 398: 747–758.
2. Wu X, Liu X, Zhou Y et al. 3-month, 6-month, 9-month, and 12-month respiratory outcomes in patients following COVID-19-related hospitalisation: a prospective study. *Lancet Respir. Med.* 2021; 9: 747–754.
3. Evans RA, McAuley H, Harrison EM et al. Physical, cognitive, and mental health impacts of COVID-19 after hospitalisation (PHOSP-COVID): a UK multicentre, prospective cohort study. *Lancet Respir. Med.* 2021; 9: 1275–1287.
4. Shah W, Hillman T, Playford ED et al. Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline. *BMJ* 2021; 372: n136.
5. Soriano JB, Murthy S, Marshall JC et al. A clinical case definition of post-COVID-19 condition by a Delphi consensus. *Lancet Infect. Dis.* 2022; 22: e102–e107.
6. Carfi A, Bernabei R, Landi F et al. Persistent Symptoms in Patients After Acute COVID-19. *JAMA* 2020; 324: 603–605.
7. Wong AW, Shah AS, Johnston JC et al. Patient-reported outcome measures after COVID-19: a prospective cohort study. *Eur. Respir. J.* 2020; 56.
8. Raghu G, Wilson KC. COVID-19 interstitial pneumonia: monitoring the clinical course in survivors. *Lancet Respir. Med.* 2020; 8: 839–842.

9. Nurek M, Rayner C, Freyer A et al. Recommendations for the recognition, diagnosis, and management of long COVID: a Delphi study. *Br. J. Gen. Pract.* 2021; 71: e815–e825.
10. Baraniuk C. Covid-19: How Europe is approaching long covid. *BMJ* 2022; 376: o158.
11. Huang C, Huang L, Wang Y et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. *Lancet* 2021; 397: 220–232.
12. Mann DM, Chen J, Chunara R et al. COVID-19 transforms health care through telemedicine: Evidence from the field. *J. Am. Med. Inform. Assoc.* 2020; 27: 1132–1135.

FIGURE LEGENDS

Figure 1: Prevalence across different European Countries of four different aspects characterizing post-COVID-19 syndrome programs, including multidisciplinary approach (panel A), telemedicine availability (panel B), rehabilitation availability (panel C) and first follow-up visit timing (panel D). Responses until September 2021 were collected from 130 centers across 26 countries (25 from Italy, 13 each from Greece and Spain, 10 from United Kingdom, 9 from France, 7 from the Netherlands, 5 each from Belgium, Poland and Turkey, 4 each from Germany, Croatia, Romania and Switzerland, 3 from Portugal, 2 each from Austria, Bulgaria, Hungary, Lithuania, Russian Federation, Serbia, Ukraine and 1 each from Denmark, Ireland, Israel, Republic of Moldova and Sweden).



A. Multidisciplinary approach



B. Telemedicine availability



C. Rehabilitation availability



D. First follow-up visit timing

Prevalence across different European Countries of four different aspects characterizing post-COVID-19 syndrome programs, including multidisciplinary approach (panel A), telemedicine availability (panel B), rehabilitation availability (panel C) and first follow-up visit timing (panel D). Responses until September 2021 were collected from 130 centers across 26 countries (25 from Italy, 13 each from Greece and Spain, 10 from United Kingdom, 9 from France, 7 from the Netherlands, 5 each from Belgium, Poland and Turkey, 4 each from Germany, Croatia, Romania and Switzerland, 3 from Portugal, 2 each from Austria, Bulgaria, Hungary, Lithuania, Russian Federation, Serbia, Ukraine and 1 each from Denmark, Ireland, Israel, Republic of Moldova and Sweden).