



# An integrated multidisciplinary model of COVID-19 recovery care

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## Abstract

**Background** In January 2020, the WHO declared the SARS-CoV-2 outbreak a public health emergency; by March 11, a pandemic was declared. To date in Ireland, over 3300 patients have been admitted to acute hospitals as a result of infection with COVID-19.

**Aims** This article aims to describe the establishment of a COVID Recovery Service, a multidisciplinary service for comprehensive follow-up of patients with a hospital diagnosis of COVID-19 pneumonia.

**Methods** A hybrid model of virtual and in-person clinics was established, supported by a multidisciplinary team consisting of respiratory, critical care, infectious diseases, psychiatry, and psychology services. This model identifies patients who need enhanced follow-up following COVID-19 pneumonia and aims to support patients with complications of COVID-19 and those who require integrated community care.

**Results** We describe a post-COVID-19 service structure together with detailed protocols for multidisciplinary follow-up. One hundred seventy-four patients were discharged from Beaumont Hospital after COVID-19 pneumonia. Sixty-seven percent were male with a median age (IQR) of 66.5 (51–97). Twenty-two percent were admitted to the ICU for mechanical ventilation, 11% had non-invasive ventilation or high flow oxygen, and 67% did not have specialist respiratory support. Early data suggests that 48% of these patients will require medium to long-term specialist follow-up.

**Conclusions** We demonstrate the implementation of an integrated multidisciplinary approach to patients with COVID-19, identifying those with increased physical and mental healthcare needs. Our initial experience suggests that significant physical, psychological, and cognitive impairments may persist despite clinical resolution of the infection.

**Keywords** COVID-19 · Critical care · Multidisciplinary model · Psychiatry · Respiratory

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## Introduction

In December 2019, a cluster of cases of severe acute viral pneumonia were first described in Wuhan, China. In January 2020, the World Health Organization (WHO) declared SARS-CoV-2 infection (COVID-19) a public health emergency. To date, there have been over 10 million cases confirmed worldwide [1]. In Ireland, more than 3300 confirmed cases have required hospital admission, with over 430 of these requiring intensive care unit (ICU) support [2].

While the long-term respiratory and functional limitations associated with COVID-19 pneumonia are yet to be fully understood, evidence from SARS-CoV-1 and the Middle East Respiratory Syndrome coronavirus (MERS-CoV) show a persistent physiological impairment among affected patients, with some developing permanent respiratory complications such as pulmonary fibrosis [3] [4].

It is known that those who survive critical illness not only have significant mortality and morbidity in the short to medium term but also experience significant psychological and physical dysfunction in the longer term. The physical and psychological difficulties experienced by critical care survivors result in frequent readmissions to hospital and subsequent healthcare resource utilization [5–7].

ICU admission is associated with particularly high rates of mental health complications as 33–75% of critical care survivors have clinically significant psychiatric or cognitive difficulties 1-year post-ICU stay [8, 9]. Rates are likely to be even higher for those who experienced COVID-19 due to the particular stressors associated with this condition [10, 11]. This will result in a significant need for integrated psychosocial assessment and follow-up care for patients discharged from critical care settings.

The RCSI group COVID recovery service was established to provide an enhanced follow-up service to organize essential medical care and rehabilitation for those admitted with COVID pneumonia. The goal of the service is to deliver high quality care, reduce duplication of services, and reduce waiting times for patients after COVID-19. The surge of patient presentations also poses the challenge of a surge of patients for follow-up; thus a novel approach was required.

The described service is a multidisciplinary assessment and treatment system which includes a virtual phone-based assessment of patients admitted to Beaumont Hospital with COVID pneumonia. The team is made up of respiratory, intensive care medicine, infectious diseases, and psychiatry and psychology services to deliver appropriate and effective treatment strategies for patients after admission for COVID-19 pneumonia.

During the initial pandemic surge, approximately 400 patients were required acute medical admission to Beaumont Hospital with COVID-19 infection and 220 for the management of severe (ward based) and critical illness (ICU) related to respiratory failure. It is anticipated that approximately half

of these patients will need medium to long-term follow up in a COVID survivorship clinic. It is envisioned that a large proportion of patients will be discharged to the community for integrated care with their GP and community mental health services, or followed longitudinally by specialist services such as respiratory medicine.

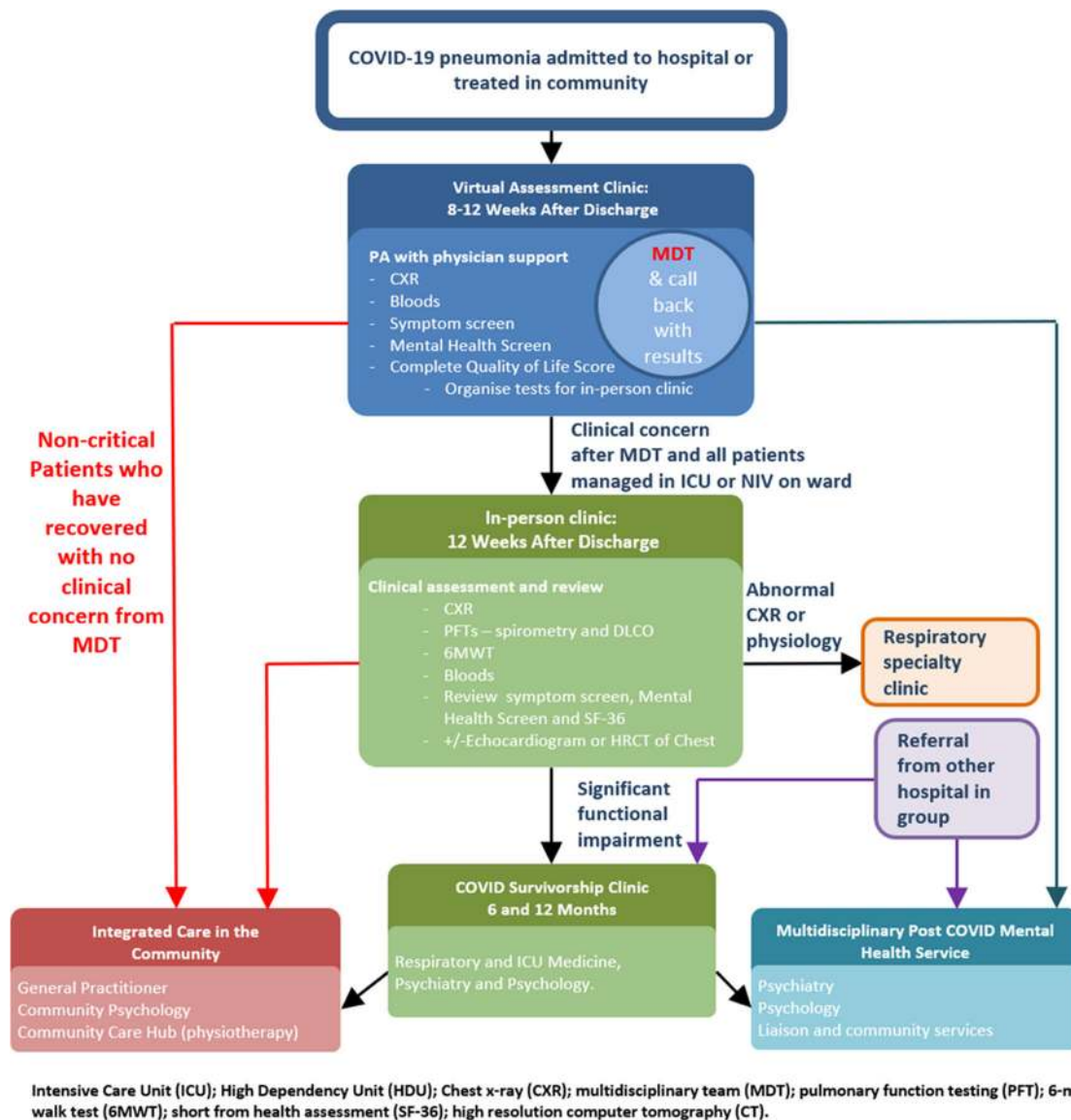
## Aims of service

The overall aim of the service is to create a safe, effective, and multidisciplinary approach for patient follow-up after a diagnosis of COVID-19 pneumonia. The service plan was based on best international practice and in accordance with the British Thoracic Society guidelines [12] on post-COVID-19 patient care. The specific goals of the service are to optimize the usage of outpatient services by utilizing virtual assessment for the majority of patients, to reduce the use of the emergency department for assessment or admission, and to minimize the impact on overstretched outpatient departments. The multidisciplinary and hybrid of virtual and in-person approach described here can also be used as an exemplar for integrated chronic disease management and mental health service delivery in any healthcare setting during and after the COVID-19 pandemic.

## Service description and overview

One hundred seventy-four patients were discharged from Beaumont Hospital between March 15 and June 30, 2020, after treatment for COVID-19 pneumonia. Sixty-seven percent were male with a median age (IQR) of 66.5 (51–97). Twenty-two percent were admitted to the ICU for mechanical ventilation, 11% had non-invasive ventilation or high flow oxygen on a specialist respiratory ward, and the remaining 67% had their care on a medical ward without the need for specialist respiratory support.

The COVID recovery outpatient service consists of an enhanced and virtual pathway, supported by a weekly multidisciplinary meeting involving all supporting specialties (Fig. 1). Enrolment into the service is based on a diagnosis of pneumonia on the admission chest X-ray, with a positive PCR test or a clinical diagnosis of COVID-19. All patients have a follow-up chest X-ray, blood testing, and complete a standardized phone-based assessment of symptoms, mental health status, and quality of life. Subsequently, their cases are discussed at the COVID recovery multidisciplinary meeting (MDM). All patients who were admitted to the ICU, or who required non-invasive ventilation at ward level, have enhanced follow-up at an in-person clinic. Patients who were admitted to the ward, but did not require ICU admission or non-invasive ventilation, have a virtual follow-up and are discharged to community



**Fig. 1** COVID recovery clinic clinical pathway. Patients that are hospitalized with COVID-19 pneumonia are followed up in an integrated multidisciplinary service. All patients receive a standardized assessment with a symptom and mental health screens and SF-36 quality of life

questionnaire. They also have a chest X-ray and blood tests. All patient cases are discussed at the COVID recovery multidisciplinary meeting, and a personalized plan is made

services unless a significant residual impairment is identified. This is then discussed at the COVID recovery MDM. This multidisciplinary approach encourages appropriate discharge to integrated community care with referral to relevant community services. Patients with greater medical, rehabilitation, and psychiatric and psychological needs will have an in-person assessment and may need a follow-up in a specialized survivorship clinic for 12 months.

**Virtual multidisciplinary assessment**

British Thoracic Society guidelines [12] recommend that all patients who were admitted to the hospital with COVID-19 pneumonia receive clinical follow-up regardless of severity.

The RCSI COVID recovery service will carry out an initial assessment of all patients by phone at 8–12 weeks post-discharge from the hospital or ICU. This virtual follow-up will ascertain their level of residual symptoms after COVID-19, functional capacity, quality of life scores, and the presence of mental health difficulties using a standardized questionnaire. The 36-Item Short Form Health Survey (SF-36) is a standardized evaluation of a patient’s physical and mental health status and has previously been utilized as a tool to quantify disability for survivors of acute respiratory distress syndrome (ARDS) [13, 14].

This virtual clinic is run by a physician associate (PA) with oversight and governance from respiratory and infectious diseases, psychiatry, and ICU consultants. After initial basic

investigations, including chest X-ray and blood tests (full blood count, renal, liver and bone biochemistry, BNP, D-dimer, and serum sample for SARS-CoV-2 antibody), each case is discussed at the COVID recovery MDM. A consensus is reached by the MDM to triage the patient to in-person or virtual follow-up and also if mental health follow-up is required. If no further specialist follow up is necessary, patients will be discharged to their GP with community follow-up as required.

Thus far, 50 patients have been reviewed at the MDM, 26/50 have been discharged to their GP, while 24/50 will require follow-up in the in-person COVID recovery clinic and with other specialty clinics.

### COVID recovery in-person clinic

Patients identified as having persistent symptoms or radiographic changes at their initial virtual clinic review are offered an in-person clinic follow-up. Patients who were critically ill due to COVID-19, i.e., requiring ICU or non-invasive ventilation, are automatically offered an in-person follow-up at 12 weeks. This cohort of patients then receives an enhanced schedule of investigations including pulmonary function testing and 6-min walk testing, and some may require a CT thorax or an echocardiogram depending on clinical indications. All of these investigations will be reviewed at the COVID recovery MDM prior to being reviewed in the in-person clinic, where a personalized management plan is created for each patient. Patients with severe functional impairments may be referred onward to the COVID survivorship clinic or to a specialist clinic as deemed necessary. The COVID recovery clinic will also receive referrals from other RCSI group hospitals for discussion at the MDM.

### COVID survivorship clinic

Established guidelines recommend that all critical care survivors should be reviewed 2–3 months after discharge, with the majority requiring a follow-up to at least 1 year [15, 16]. The best practice post-ICU recommendations include a follow-up for all patients with an ICU stay of > 72 h, selected patients with an ICU stay of > 48 h, and any ICU patient with risk factors for psychological dysfunction [17]. Many COVID-19 survivors fulfill these criteria and are an at-risk group that requires follow-up.

Although it is difficult to quantify improvement in outcomes, qualitative studies have shown improvement for patients, and subjective outcomes studies have demonstrated improvements in SF36 scores, a surrogate for quality of life [18].

**Fig. 2** Post-COVID mental health service screening questionnaire. Initial telephone triage tool to help identify patients at risk for mental health issues or who are currently experiencing mental health or cognitive symptoms. This system employs a traffic light system to help stratify patients and gains consent from the patient to be enrolled to a further in-depth cognitive and mental health assessment

### COVID recovery mental health service

The COVID recovery service implements a brief telephone triage (Figs. 2 and 3), which includes both mental health and cognitive symptoms. Following the initial screening, those deemed in need of further mental health assessment and intervention are followed-up with stage 2 screening, which comprises of a telephone call and postal questionnaires from the COVID mental health service (COVPSYCH) team. The telephone call will include a brief objective and subjective screen of cognition. If the stage 2 screen is positive, a clinic or virtual appointment will be arranged with the COVPSYCH team within 4 weeks, whereby a full clinical assessment will be carried out, including cognitive testing where appropriate. If required, pharmacological and therapeutic intervention is instigated on a case-by-case basis.

### Discussion

As a novel condition, the COVID-19 pandemic has presented clinicians with a unique challenge in regard to the appropriate follow-up of affected patients. Among the anticipated complications of COVID-19 infection include long-term respiratory impairment and post-ICU complications such as neuromuscular dysfunction, psychological dysfunction, and cognitive impairment. This has created the necessity for an integrated and comprehensive follow-up service, encompassing all members of the multidisciplinary model.

While the respiratory sequelae of COVID-19 are yet to be fully described, it is anticipated that patients will experience some degree of persistent respiratory symptoms or disease, reflecting the pattern of disease progression seen in the 2002–2004 SARS outbreak [19]. Prospective studies following healthcare workers with SARS-1 showed residual physiological impairment up to 2 years after infection [4]. This deficit was mainly demonstrated in the form of reduced gas transfer, with DLCO less than 80% of the predicted value in over 50% of patients studied.

There is emerging evidence that suggests that pulmonary thromboembolism is likely an under-reported morbidity associated with COVID-19 that carries a potentially significant burden of long-term complications including pulmonary hypertension [20]. In addition, previous studies have shown that acute lung injury is associated with pulmonary fibrosis on CT imaging and correlates with restrictive physiology and poorer

## Post COVID Mental Health Service Screening Questionnaire

MRN:  
Date:  
Referrer:

Preferred contact number:  
Explicit consent to further screening obtained?

### Stage 1:

#### Initial Telephone Triage:

“I’m now going to ask you a couple of questions in relation to your mental health and psychological well-being”

#### A) Traffic Light Screen:

- Q1. Do you have a past or present history of mental illness? (Y/N)
- Q2. Have you previously required inpatient care for your mental health? (Y/N)
- Q3. Are you on medication for your mental health? (Y/N)

**Status: (Yes Count)**  
≤ 1 = Green  
2 = Yellow  
3 = Red

Status

#### B) Depression Screen: “In relation to your mood...”

- Q.4 During the last month, have you often been bothered by feeling down, depressed or hopeless? (YES/NO) → 0 / 1
- Q. 5. During the last month, have you often been bothered by little interest of pleasure in doing things? (YES/NO) → 0 / 1

Yes (score 1) to Q4 or Q5 considered a positive screen

Y / N

#### C) Anxiety Screen: “Over the last 2 weeks, how often have you been bothered by the following problems?”

- Q.6. Feeling nervous, anxious, or on edge (0-3; 0 = None) → 0 / 1
- Q.7. Not being able to stop or control worrying? (0-3) → 0 / 1

A cumulative total score >3 for Q.6 & Q.7 is the cut-off

Y / N

#### D) Cognitive Screen: “During the past 2 weeks, how much (or how often) have you been bothered by:

- Q. 8. Problems with memory (e.g., learning new information) or with location e.g., finding your way home)?”

None	Slight	Mild	Moderate	Severe
Not at all	Rare	Several says	More than half the days	Nearly everyday
0	1	2	3	4

Score of ≥2

Y / N

- Q. 9 “Are you happy to be contacted by the COVID Mental Health Service in Beaumont Hospital to follow-up on these concerns with your **emotions** and/or **memory or concentration** problems?”

Y / N

If **YES** on **A, B, C, or D, AND on Q9.**, initiate **Stage 2 Screening**; inform patient that a questionnaire will be posted to them, followed by a follow-up phone call with a mental health professional from Beaumont.

If **NO**, record and proceed with remainder of routine call

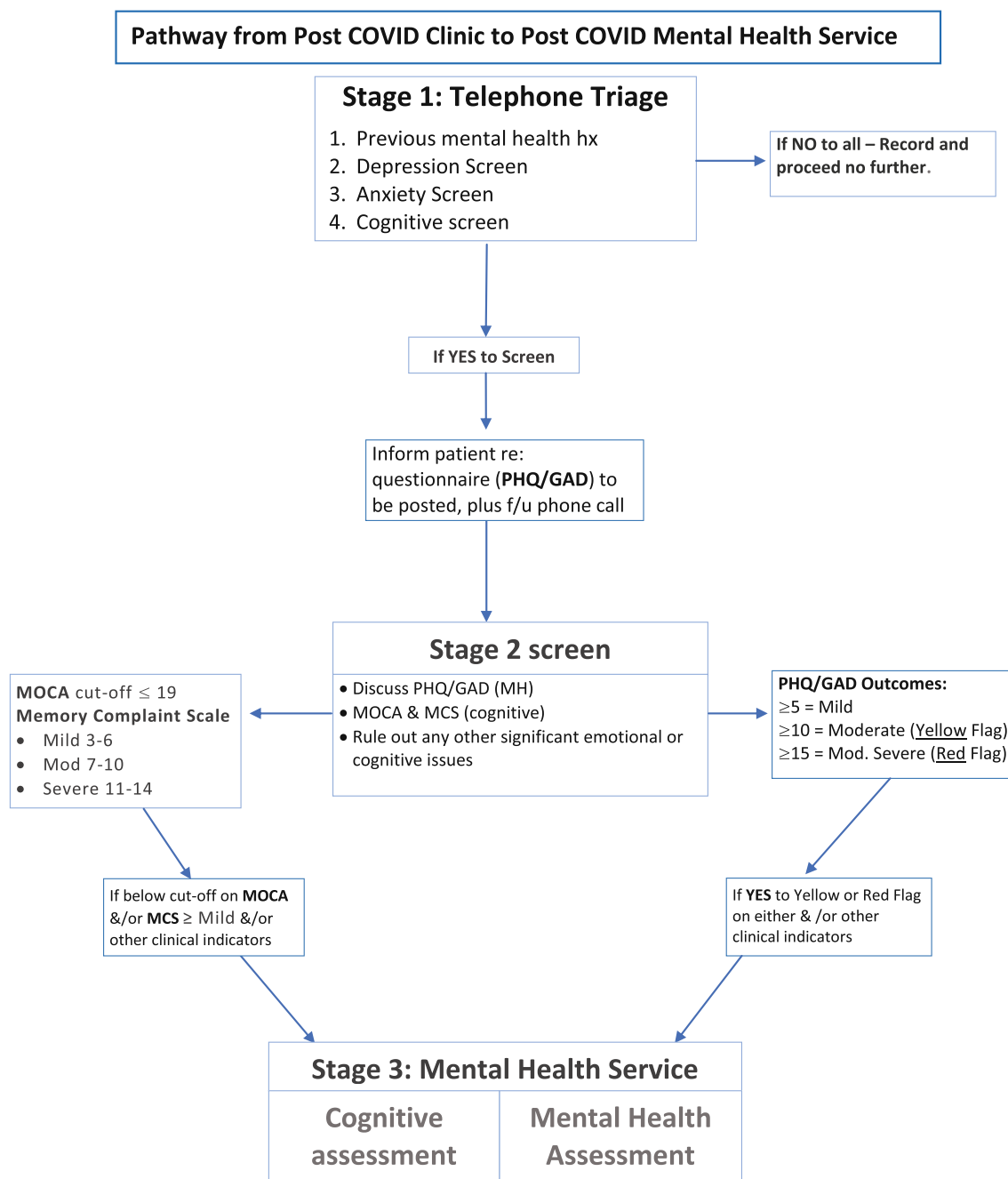
#### Stage 2 Screen:

PHQ-9 and GAD-7 to be posted, plus follow-up call from Mental Health Service

**PHQ/GAD Outcomes:**  
≥5 = Mild  
≥10 = Moderate (**Yellow Flag**)  
≥15 = Mod. Severe (**Red Flag**)

Yellow or Red Flag on either?

If Yellow or Red Flags present on either **Depression** or **Anxiety**, or both, at Stage 2 Screening and/or confirmation of other significant emotional or cognitive problems detected over phone call assessment; patient will be invited for further follow-up through the Post-COVID Mental Health Service



**Fig. 3** Description of multidisciplinary model for mental health assessment. A staged mental health assessment consisting initially of a virtual triage assessment. Patients at risk for mental health or cognitive

issues continue to stage 2 of the model where they have an in-depth assessment in person and proceed to a long-term follow-up as appropriate

health-related quality of life [21]. These possible consequences of COVID-19 pneumonia highlight the unique challenge facing clinicians in the immediate aftermath of the pandemic surge due to restricted access to diagnostic imaging and pulmonary function testing due to infection control guidelines. This is an important factor to consider within the practicalities of any clinic structure and highlights the importance of the multidisciplinary model for decision-making purposes.

Despite guidelines on best practice, only 30% of ICUs in the UK and no ICUs in Ireland currently provide outpatient follow-up [15]. Although quantitative studies are weak, qualitative reports suggest a clear benefit [22]. Indeed, the structure of the clinic is considered to be the important determinant in terms of patient outcome. Inter-disciplinary teams (critical care & respiratory medicine with occupational therapy, psychology, physiotherapy, and pharmacy input) are associated

with longitudinal improvements in outcomes at 2.5-month intervals [22].

Mental health comorbidity in the acute hospital setting is associated with significant adverse consequences including increased health service and other costs, prolonged length of stay, earlier readmission rates, more frequent emergency department attendances, and poorer health outcomes [23]. COVID-19 is associated with a significant mental health burden in both the acute phase and the long term [24]. Anxiety, depression, insomnia, and post-traumatic stress disorder are common following severe coronavirus infections [25, 26]. One-third of the first 153 COVID-19 cases reported in the UK were diagnosed with mental health problems including psychosis, cognitive decline, and affective disorder [24].

### Challenges of implementation

Establishing a novel service of this nature presents its own challenges in the context of an already overstretched healthcare system. Resource management and the identification of additional staff, including a dedicated PA, have allowed for appropriate and timely follow-up and created a streamlined process for all patients. The coordination and cooperation of various departments including radiology, pulmonary physiology, phlebotomy, psychiatry, and psychology are integral to the success of instituting a multidisciplinary service such as this.

Some barriers we have encountered thus far are mainly focused on communication, particularly within the confines of a virtual clinic. We recognize that limitations exist in assessing patients over the phone, particularly in regard to language barriers with patients who do not speak English as their first language. While the SF-36 is an excellent tool to assess functional and cognitive limitations following an acute illness, patients may be reluctant to discuss sensitive mental health questions over the phone. As a result, we may underestimate the burden of physical and mental health issues in this cohort.

The practicalities of organizing an in-person clinic for any patient group during the rapidly evolving phases of a pandemic are challenging. Social distancing has reduced the volume of patients we can assess in one sitting and creates difficulties for patients navigating the hospital for their various investigations. Outsourcing of some initial investigations to satellite sites has helped to ensure that all relevant investigations are completed in accordance with our scheduling guidelines. However, we have already seen some non-attendances in our critical patient group as a result of mental and physical barriers post COVID-19.

### Conclusions

In summary, we have demonstrated the design and implementation of an integrated multidisciplinary service for patients

after admission to hospital with COVID-19 pneumonia. We have already shown that this service can assess patients using a hybrid of virtual and in-person clinics and assign appropriate follow-up for patients with complex physical and mental health needs. It is anticipated that this timely and comprehensive approach should lead to better outcomes for a novel disease with little precedent in the literature or clinical practice in Ireland or internationally. We envisage that our approach to COVID-19 recovery will improve the overall quality of patient care and strengthen patient acceptance for enhanced follow-up that may be the subject of future longitudinal studies.

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**Authors' contributions** KH, IS, FK, EDB, HB, and NP conceived the clinic structure and protocols and contributed to writing the manuscript. HOB researched the literature and wrote the first draft of the manuscript. All authors critically revised and approved the final version of the manuscript.

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