

Post-COVID-19 Management: Comprehensive Assessment at Post-COVID-19 Monitoring Centre

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Abstract

Objective: The 2019 Coronavirus disease-2019 (COVID-19) is a novel disease that affects multiple systems. Several details about its long-term effects are unknown. Follow-up and early detection of post-COVID conditions could help improve outcomes. We established a multidisciplinary "Post-COVID-19 Monitoring Centre" in Istanbul University Medical School Hospital and aimed to introduce this centre to represent a model for centres that would provide post-COVID care.

Materials and Methods: We outlined the multidisciplinary healthcare team professions, the schedule for organising the appointments and specific intervals, and the items of comprehensive assessment and the consultant services at the centre.

Results: The first appointment for inpatients and outpatients are scheduled at first month after discharge and 1 month after symptoms have resolved, respectively, and at 3-month intervals thereafter unless necessitated more often. The specialists involved in post-COVID-19 care are internal medicine, respiratory medicine, infection disease, geriatrics and nutrition, psychiatry, public health medicine and consultant specialists (radiology, ophthalmology, gastroenterology, cardiology and neurology). Geriatricians come at the forefront as experts and case managers that can integrate and manage the multidisciplinary team because of their experience and practices in routine care.

Conclusion: Comprehensive assessment and follow-up of COVID-19 recovery patients would help us understand the long-term consequences of the disease. We reveal that multidisciplinary management of COVID-19 survivors may greatly improve outcomes in several aspects. Moreover, we suggest that setting up similar centres for post-COVID-19 care contributes to the management of this pandemic globally.

Keywords: Post-COVID-19, multidisciplinary team, long-term consequences, care, follow-up

Introduction

New coronavirus, Severe Acute Respiratory syndrome-coronavirus-2 (SARS-Cov-2), is an important human and animal pathogen which has been identified at the end of the 2019 in Wuhan (China) and has rapidly spread to all countries throughout world. This pandemic related to Coronavirus disease-2019 (COVID-19) has resulted in more than 27 million confirmed cases and more than 890,000 deaths worldwide

(1). Although most people are asymptomatic, symptomatic infection occasionally occur and the symptoms vary among patients. The respiratory system is the most effected system with common symptoms of dry cough, fever, fatigue, shortness of breath (2). Previous evidence demonstrated that the virus can be more than just respiratory symptoms that can also attack the other systems including cardiovascular, gastrointestinal, urinary system, coagulopathies, cutaneous

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manifestations, neurological system. In addition, there are comorbidities and conditions that affect severity of COVID-19, i.e., age, diabetes mellitus, hypertension, cancer and obesity (3,4). Moreover, information and experience about long-term consequences of COVID-19 is not enough known yet, as it is a very new disease with only a few months history. On the other hand, evidence from two previous outbreaks of other coronaviruses (SARS and MERS) could help guiding scientists for potential long-term sequels of it (5,6). With the light of this background, multidisciplinary attitude is important in management and follow-up of the COVID-19.

The main aim after acute-term treatment of the disease should be identifying and following the biological and psychosocial long-term consequences, as well. Based on acute term data and previous coronaviruses outbreaks' evidence, a comprehensive assessment of the individuals is required to understand and manage the long-term effects. At this aspect, geriatricians are the experts that can integrate and manage the multidisciplinary team as case managers because they are very experienced in this regard and involved in similar practices in their routine care. For this purpose, İstanbul University Medical Hospital (İstanbul, Turkey) has constituted a multidisciplinary healthcare service called "Post-COVID-19 Monitoring Centre". To our knowledge, this is the second multidisciplinary center dedicated to this purpose (7). Geriatricians, the specialties that take part in acute management of COVID-19, i.e., emergency medicine, internal medicine, infectious diseases, pulmonary diseases, radiology, and intensive care are involved in this center together with the specialties from public health, psychiatry, ophthalmology, gastroenterology, cardiology and neurology to display multidisciplinary examination in the post-COVID-19 Monitoring Centre (Table 1).

Table 1. Specialties take part at post-COVID assessment	
Internal medicine	
Respiratory medicine	
Infectious diseases	
Geriatrics and nutrition	
Psychiatry	
Radiology	
Public health medicine	
Consultant specialties	Radiology Ophthalmology Gastroenterology Cardiology Neurology
COVID-19: Coronavirus disease-2019	

Materials and Methods

The Methods of Care in the Post-COVID-19 Center

Appointment for post-COVID-19 monitoring centre

COVID-19 patients present with variety of symptoms amongst individuals, ranging from asymptomatic infection to severe respiratory failure. Recovery duration depends on preexisting illnesses and comorbidities and their severity and patient ages. However, COVID-19 is a new worldwide disease, there is no data about its long-term complications of inpatient and outpatient patients. Persistent symptoms after recovery were reported (8,9). İstanbul University post-COVID-19 Monitoring Center has been established for the purpose to identify the problems that may develop in the short and long term of inpatient and outpatient patients who survived the acute phase.

1. Patients who were hospitalized and monitored at the İstanbul Medical Faculty pandemic wards and were followed up at home with a diagnosis of COVID-19 are called by phone and arranged an appointment to the monitoring center. Additionally, patients who were treated in a different hospital can also apply to the monitoring center by making an appointment by phone.
2. The first appointment for the inpatients is created after the first month after discharge.
3. The first appointment for the patient's followed up at home is created one month after symptoms have resolved.
4. Patients who require close monitoring after the first monitoring center assessment, the second appointment is made according to the physician's decision. If there is no special condition, the second appointment is made for 3 months later, and the patient is notified before leaving the center.

Statistics

Quantitative variables are expressed as mean ± standard deviation if they contain continuous data. If they contain categorical data, they are expressed as percentage (%) and frequency (n).

Comparison of qualitative variables was analyzed using the Pearson chi-square test. The normal distribution, which was used to question the presence of parametric data in the data containing the measurement, was examined by Kolmogorov-Smirnov and Curtosis-Skewness tests. Age showed normal distribution, which could be parametric. A Student's t-test was used to compare parameters including only age.

Kruskal-Wallis test was used for the analysis of continuous and more than two independent non-parametric groups (Bonferroni correction was used when necessary) and Mann-Whitney U test was used for post-hoc analysis. receiver operating characteristic (ROC) curves dependent groups were handled one by one, ROC

curves were drawn and "area under the curve (AUC)", "sensitive (sens) and specificity (spes) of cut-off values" were shown. Additionally, the optimum cut-off point suggestions were given for the parameters. Patient data that exceeds the cut-off value indicates that it involves a high risk in that parameter. The closer the AUC value is to 100, the better the cut-off points are, in that regard. This study suggested that these cut-off values can be used for these parameters in healthcare facilities, which are considered to include practically similar patients. The results were evaluated in 95% confidence interval and statistical significance level was defined as $p < 0.05$. The analyzes were performed using IBM SPSS-21 (Statistical Package for Social Sciences, Chicago, IL, USA).

Comprehensive Assessment at the Post COVID-19 Monitoring Center

During comprehensive assessment, a number of CGA components have been applied by different specialists at post- COVID-19 care center (Table 2).

General Assessment

Vital signs and blood collection

The patient, after ID check is completed, is directed to the blood drawing unit. The patient's fever, blood pressure, pulse, oxygen saturation measurement is recorded, and blood drawing is performed by the nurse in charge.

Laboratory

Recent studies have shown reinfection with coronavirus, re-hospitalization need, long-term pulmonary sequelae, and post-traumatic stress disorder (10,11). Common laboratory abnormalities among hospitalized patients with COVID-19 include lymphopenia, elevated aminotransaminase levels, elevated lactate dehydrogenase levels, elevated inflammatory markers (e.g., ferritin, C-reactive protein, and erythrocyte sedimentation rate), and abnormalities in coagulation tests

(12). In addition to these laboratory parameters, lipid profile and thyroid function tests and parathormone level are checked at the first visit. Quarantine itself and long-term hospitalization are associated with decreased physical activity and unhealthy diet that could provoke cardiovascular disease (13). Evaluating blood lipid profile at the early stage could guide physicians. Previous evidence of other coronaviruses showed that thyroid follicular cells and parafollicular cells were also injured, thus could reflect with abnormalities of the TT3, TT4, TSH and PTH levels (14,15). Thyroid functional abnormalities may be correlated with the severity of COVID-19 (16).

Antibody tests are important for determining seroprevalence in a particular population, detecting and monitoring population immunity (17). All recovered patients' blood are collected for assessing antibodies

Internal Medicine Assessment

The patient is directed to the internal medical specialist after vital signs monitoring and blood sample collection. Patients' past records during the hospitalization at the Istanbul Medical Hospital pandemic services are checked before the assessment. Comprehensive medical assessment including detailed clinical and pharmacologic history, physical examination, anthropometric measurements were performed to the patients by the internal medical specialist. COVID-19 symptoms such as cough, chest pain, shortness of breath, nausea and diarrhea are asked using a standard questionnaire enrollment. The presence of an additional or new onset complaint of recovery COVID-19 patients is also recorded. Previous study reported post-COVID-19 patients had persistence of at least 1 symptom, mainly fatigue and dyspnea (8).

Respiratory Medicine Assessment

The spectrum of symptomatic infection ranges from mild to severe, as pneumonia appears to be the most common severe manifestation of COVID-19 infection, mostly characterized by fever, cough, shortness of breath. Computed tomography (CT) findings may differ depending on time points and severity of the diseases. Typical chest imaging findings are usually multifocal, bilateral and peripheral ground-glass opacification with or without consolidative abnormalities, consistent with viral pneumonia (18). However, the early phase of the disease may present as a single lesion, most commonly located in the inferior lobe of the right lung (19).

Previous early study has found decreased lung function and residual imaging abnormalities at the first month after discharge (20). Decreased lung function might not be reversible. Although not much is known about long-term respiratory complications for COVID-19 patients, there are a lot of information for other coronaviruses SARS and MERS. Experience showed that the impact of the new coronavirus

Table 2. Components and methods of the comprehensive geriatric assessment for post-COVID-19 follow-up

Frailty	FRAIL
Malnutrition	GLIM and MNA-SF
Sarcopenia	SARC-F, BIA (skeletal muscle mass index (SMM)/height ²)
Physical performance	Hand grip
Anthropometric evaluation	Body weight, BMI
Geriatric syndromes	Falls, sleep disorder, urinary and fecal incontinence, constipation, vertigo, forgetfulness, anhedonia
Activities of daily living	Katz-ADL, Lawton&Brody-IADL

FRAIL: Simple frailty questionnaire, GLIM: Global Leadership Initiative on Malnutrition, MNA-SF: Mini nutritional assessment-short form, SARC-F: Simple frailty questionnaire, BIA: Bioelectrical impedance analyses, BMI: Body mass index, ADL: Activities of daily living, IADL: Instrumental activities of daily living, COVID-19: Coronavirus disease-2019

on the pulmonary system is similar with those of SARS and MERS (21). Persistent lung injury was detected at the previous epidemics (6,22).

In the light of these, the long-term following up of pulmonary function will be important for reducing pulmonary functional impairment by making an early decision to consult the patient on chest physiotherapy and functional rehabilitation. After the acute phase of COVID-19, 6-minute walking test and spirometry are planned on the sixth month.

Patients with severe pulmonary findings at the initial diagnosis of COVID-19 have a control low-density thoracic CT at the same day in the post-COVID-19 monitoring center. The patients who have severe respiratory distress and newly developed suspicious opacification are directed to hospitalization.

Geriatrics' Assessment

COVID-19 is typically more severe and lethal among older people and they are at significantly increased risk for morbidity and mortality (12). However, older adults with chronic conditions (e.g., diabetes, chronic pulmonary disease, heart failure, cancer, dementia, polypharmacy) have greater impairment in immunity. Even more physiological chances of aging itself causes a decrease in the cell-mediated and humoral immune system (23), resulting in greater sensitivity to common infections. In addition, older adults with COVID-19 or other infection diseases may present with subtle findings. Clinicians should bear in mind the illnesses could present in older adults with non-specific symptoms such as falls, confusion or worsening functional impairment (24). Any preexisting medical condition could be worsened at infected older patients. The presence of multiple factors of COVID-19 in elderly patients could influence the physical or cognitive frailty that complicates patient prognosis. Therefore, it requires a multidisciplinary assessment and management for elderly patient's demands. In this regard, geriatricians are probably best doctors on management of elderly COVID-19 patients. Geriatricians at İstanbul University post-COVID-19 Monitoring Centre work in teams with internal medicine specialists, infection disease specialists, pneumonologists, and psychiatrists. COVID-19 patients over the age of 65 are examined by the geriatricians in this unit, in terms of evaluating their nutritional status and geriatrics syndromes. A meta-analysis demonstrated that comprehensive geriatric assessments (CGA) benefit on physical and functional status and mortality (25). Detailed model is organized for the assessment of elderly COVID-19 people in purpose of providing them the most suitable treatment and care for their needs (Table 3). The components of CGA chosen for post-COVID-19 care were screening/assessments of physical frailty, nutritional status, sarcopenia, physical performance, anthropometric evaluation, geriatric

Table 3. Components of care applied in post-COVID-19 care center

General assessment	Vital signs: Fever, oxygen saturation, heart rate, blood pressure Laboratory assessment: Glucose, creatinine, BUN, electrolytes, uric aside, liver enzymes (AST, ALT, GGT, LDH) cholesterol levels (LDL, HDL, total cholesterol, triglycerides), CK, albumin, total protein, troponin, D-dimer, pro-BNP, INR, aPTT, ferritin, fibrinogen, hemogram, inflammatory markers (CRP), thyroid function test and antibodies, Antibody of SARS-CoV-2 infection
Internal medicine	Medical, clinical and drug history Allergy Vaccination history (BCG) Lifestyle (smoking) Past and present signs and symptoms of COVID-19 Treatment received for COVID-19 (supplemental oxygen, antibiotics, anti-retroviral, hydroxychloroquine, immunomodulators) Use of personal protective equipment (PPE): gloves, eye protection, facemasks Electrocardiogram
Respiratory medicine	Respiratory symptoms Chest X-ray and/or chest CT scan 6-min walking test Spirometry (lung capacity for carbon monoxide) Borg scale
Infection diseases	Detecting for reinfection
Geriatrics	Anthropometric evaluation (weight, BMI) Bioelectric impedance analysis (BIA) Comprehensive geriatric assessment (fall, sleep disorder, urinary incontinence, constipation, malnutrition, sarcopenia, frailty) Tests: FRAIL, MNA, SARC-F, the Barthel ADL, the Lawton IADL index, GLIM Physical performance (hand grip)
Psychiatry	Psychiatric disorders (hospital anxiety and depression scale (HADS), impact of event scale-revised (IES-R))
Radiology	Chest X-ray and or chest CT scan
Cardiovascular assessment	Echocardiography
Gastroenterology	Gastrointestinal symptoms or history of chronic gastrointestinal diseases
Ophthalmology	Ophthalmological assessment
Public health medicine	Socio-demographic status Socio-economic status Self-determinations/fears/self-confidence
Neurology	Central and peripheral nervous system evaluation (if necessary cranial MR, cranial CT) and cognitive function

CT: Computed tomography, MR: Magnetic resonance, COVID-19: Coronavirus disease-2019, SARS-CoV-2: Severe Acute Respiratory syndrome-coronavirus-2

syndromes and functional status. These components were selected because COVID-19 is very likely to result in frailty, malnutrition, sarcopenia, physical performance deterioration, progression in geriatric syndromes and impairments in functional abilities (26).

Psychiatric Assessment

The COVID-19 pandemic may be associated with psychiatric symptoms in the general population because of the uncertainty about the consequences of the duration of the pandemic, symptoms, high mortality rates and high risk of transmission. Previous data suggest that patient with COVID-19 might experience significant psychiatric symptoms of anxiety, depression, distress, insomnia and post-traumatic stress disorder (27,28). For patients recovering from COVID-19, the psychological dimension of this pandemic has been much more dramatic. During their hospitalization these patients are isolated for long-term due to biological risk from COVID-19. There are only a few data available on psychiatric illness in COVID-19 patients. However, research on previous coronavirus outbreaks (SARS and MERS) suggest that many patients with COVID-19 will show psychiatric symptoms and disorders (28). A study investigating psychopathology in COVID-19 survivors at one-month follow-up after hospital treatment showed a high prevalence of pathological score for at least one psychiatric disorder. They predict that higher incidence of PTSD, major depression, and anxiety are expected in survivors (29). In the light of these, mental health support is important for the COVID-19 survivors to prevent the possible development of serious psychiatric disorders in the future. In order to prevent chronic psychiatric disorder, hospital anxiety and depression scale and impact of event scale-revised test are applied by the psychiatrist with patient's approval who apply to the post-COVID-19 monitoring center.

Public Health Medicine

Public health specialists are the doctors who are responsible of improving and protecting the health of people and the communities in which they live. They research diseases and illnesses; detect and try to find to prevention measures for infectious diseases. Additionally, the aim of public health is finding a way to decrease health disparities and promoting healthier lifestyles.

Public health specialists make calls for the appointment at the İstanbul University post COVID-19 monitoring center. Psychosocial questionnaire is formed for the recovered patients that involves questions about their socio-demographic analyze, physiological and socio-economical status. Patients are directed to appropriate unit (e.g., social workers specialists, psychiatrists) after the public health specialists' assessment if they needed.

Specialist Consultations

Radiology

Patients with severe pulmonary findings at the initial diagnosis of COVID-19 have control low-density chest CT on the same day at the post-COVID-19 monitoring center. Primary evaluation of chest CT is made by respiratory medicine specialist. Most commonly findings at chest CT are ground-glass opacifications (83%), ground-glass opacifications with mixed consolidation (58%), pleural thickening (52%), interlobular septal thickening (48%) and air bronchograms (46%) (30). Chest CT of COVID-19 patient is consulted to a radiologist if there are less common, unusual and unexpected findings.

Ophthalmology

There are few reports on the association of COVID-19 with ocular abnormalities as conjunctivitis, including conjunctival hyperemia, chemosis, epiphora or increased secretions (31). COVID-19 patients may have a number of complex and varied systemic coagulation abnormalities. Ocular intravascular hypercoagulation is possible situation. If required, the ophthalmology specialist will complete all ophthalmological evaluation for a possible ocular complication.

Gastroenterology

COVID-19 patients could present with gastrointestinal symptoms (e.g., nausea and diarrhea). The prevalence gastrointestinal symptoms (diarrhea, nausea/vomiting or abdominal pain) was overall stated as 18 percent (32). Post COVID-19 patients are consulted to gastroenterologist if needed especially for persistent gastrointestinal symptoms, infection related gastrointestinal complications, past history of chronic gastrointestinal diseases or an adverse drug effect.

Cardiology

Previous studies have shown interplay between cardiovascular events and COVID-19 (33,34). Different mechanisms are responsible of its effects. Hemodynamic instability and hypoxemia during acute phase could reduce myocardial oxygen demand-supply balance that lead to acute myocardial injury and toxic inflammatory cytokines may cause inflammatory myocarditis, microvascular dysfunction or prothrombotic events which may result as venous and arterial thrombosis (35). Patients with history of cardiovascular disease and risk factors including diabetes, hypertension, obesity are at high risk to develop CVD related COVID-19 (3). Based on evidence of previous coronaviruses it is not hard to predict long-term sequels of COVID-19. Trans-thoracic echocardiography is performed to patients who experienced CVD during acute-phase of COVID-19 or to patient with new onset cardiovascular symptoms during the post-COVID assessment.

Neurology

Both central and peripheral nervous system are reported to be involved during COVID-19 (36). Most common central nervous system symptoms are dizziness, headache, impaired consciousness, acute cerebrovascular disease, ataxia and seizure. Most common peripheral nervous system symptoms are disorders of taste and smell, visual impairment and nerve pain. Anosmia and dysgeusia were reported as common early symptoms (37). Neurological complications occur nearly in half of the hospitalized patients (38). Cerebrovascular diseases are infrequent and common in those with comorbidities e.g., hypertension, diabetes mellitus, cancer which also increase the occurrence and severity of COVID-19. It seems both stroke and COVID-19 have similar risk factors (39).

All neurological complications related COVID-19 are likely to have long-term consequences. Follow-up of the patients with neurological complications of COVID-19 could help to understand the viral disease better and enable physicians to take early precautions for the possible severe long-term neurological complications. Neurologists, in monitoring center, take part as consultant to evaluate patients with acute phase neurological complications or new onset neurological symptoms.

Identifying and following the biological and psychosocial long-term consequences will help to survive the COVID-19 with fewer side effects. To our knowledge, this is the second multidisciplinary center for post-COVID-19 follow-up. Similar multidisciplinary center has been established at the Fondazione Policlinico Universitario A. Gemelli IRCSS (Rome, Italy) (7). These two centers persuade same goal with minor differences. It has been reported that, in Italy, the center that represents the first multi-disciplinary post-COVID-19 follow-up center, four visits have been planned with different regular components. In our center, first visit has been planned after first month of recovery. Consequently, three more regular follow-up visits (at 3rd, 6th and 12th months) have been organized. Moreover, the internal specialist in charge directs the patients for more frequent visits in case of possible need. After multisystem evaluation, the consultation is made in case of need by guidance of the responsible physicians. The Italy center applies routine otorhinolaryngological assessment, stool and urine analyses to the all follow-up patients. Public health specialists have been taking active role in our center aiming to find a solution to decrease health disparities and promote healthier lifestyles.

Conclusion

Information and experience about long-term consequences of COVID-19 is limited yet, worldwide, as it is a very new disease with only a few months' history. Comprehensive assessment and follow-up recovery COVID-19 patients would help us to understand about its long-term consequences. We suggest

that multidisciplinary management of COVID-19 survivors could improve the quality of our care, lives of our patients in the deep sea of uncertainties. Geriatricians are the experts that come in front with their distinguished skills in managing multidisciplinary aspects and teams.

Ethics

Ethics Committee Approval: Institutional review board approved the study with the number of 28/09/2020-164155.

Informed Consent: Written consent was obtained from the participants.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Y.Ç., N.Ş., S.B., M.K., Concept: G.B., A.M., M.A.K., T.T., M.K., Design: G.B., A.M., M.A.K., T.T., M.K., Data Collection or Processing: S.G., Y.Ç., N.Ş., S.B., Analysis or Interpretation: M.M.Ö., M.K., Literature Search: S.G., Writing: G.B.

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