

British Thoracic Society Guidance on Respiratory Follow Up of Patients with a Clinico-Radiological Diagnosis of COVID-19 Pneumonia

Introduction

This guidance outlines British Thoracic Society (BTS) recommended follow up of patients with a clinico-radiological diagnosis of COVID-19 pneumonia. The COVID-19 swab status of patients is not relevant to this guidance. The entry point to this guidance is a clinical diagnosis of COVID-19 pneumonia with consistent radiological changes. This document may require updating as more information becomes available. This version was published on **Monday May 4th 2020**. Please check the [BTS website](#) for the most up to date version of this document.

This guidance focuses on the radiological follow up of the pneumonic process and the subsequent diagnosis and management of respiratory complications of COVID-19 pneumonia.

This guidance is intended to be pragmatic but sufficiently detailed to allow timely identification of patients experiencing persistent or evolving respiratory complications of COVID-19. Where possible this guidance suggests virtual solutions at relevant points along the patient pathway with the goal of mitigating the expected pressures on respiratory services after the initial COVID-19 outbreak. The lack of a robust evidence base for this new disease means that in consultation with their patient, an individual clinician can and should choose to deviate from the pathway when required.

The prevalence of post-COVID-19 respiratory complications will become apparent but data from previous coronavirus outbreaks provides important context. Between 20% and 60% of survivors of the global SARS outbreak caused by SARS-CoV and the Middle East Respiratory Syndrome coronavirus (MERS-CoV) experienced persistent physiological impairment and abnormal radiology consistent with pulmonary fibrosis.¹⁻³ Drawing on these experiences, it is envisaged that respiratory complications may be an important sequelae of COVID-19.^{4,5} There is emerging evidence that patients suffering with COVID-19 experience a high prevalence of thromboembolic disease^{6,7} and clinicians will also need to be alert to the possibility of long term complications from this. The management and follow up for these patients are addressed in greater detail in the [BTS COVID-19 guidance for venous thromboembolic disease](#).

Aims

The aim of this guidance is to ensure that patients are followed up in a timely fashion taking into account factors such as disease severity, likelihood of long-term respiratory sequelae and functional disability.

Specifically this guidance sets out to ensure that:

- The early, medium and long-term respiratory complications of COVID-19 pneumonia cases are identified and that patients are then followed up by appropriate services.
- The most serious and potentially life limiting complications of COVID-19 such as pulmonary fibrosis and pulmonary vascular disease are identified expediently with a robust follow up algorithm and are then managed appropriately.
- Patients in whom an early clinical review is recommended (see figure 1, at 4-6 weeks post discharge) are identified such that acute needs such as breathlessness, oxygen requirements, rehabilitation, palliative care/symptom management and psychosocial needs can be addressed by either hospital or community teams.
- Patients diagnosed with COVID-19 pneumonia who have made a full recovery are appropriately reassured that their CXR changes have resolved.
- Respiratory, radiology and physiology resources are coordinated and used optimally and efficiently using virtual systems where feasible given the additional workload expected to deliver high quality post COVID-19 respiratory follow up.
- Patients with hitherto undiagnosed pre-existing respiratory disease are opportunistically identified and managed as appropriate.
- If a rehabilitation referral was not possible or not offered at the point of discharge from hospital, patients are proactively reassessed for this need later in the pathway.
- At all points of patient contact teams are reminded to undertake a 'Post-COVID-19 holistic assessment' of patient needs (see FAQs: frequently asked questions - for a definition of what this may encompass).

With the intention of addressing these aims, we have defined two follow up algorithms (Figure 1 and 2) which integrate disease severity as well as the functional capacity of patients on discharge.

1) Patients admitted for hospital care with a clinico-radiological diagnosis of COVID-19 pneumonia who required ICU or HDU admission or were cared for on the ward with severe pneumonia (Figure 1).

Within this group we include:

- All patients managed on ICU or HDU
- All patients discharged with a new oxygen prescription
- All patients with protracted dependency on high inspired fractions of oxygen, continued positive pressure ventilation and bi-level non-invasive ventilation who the discharging team feel were clinically severely affected by their COVID-19 pneumonia
- Any other patient the discharging team has significant concerns about.

Patients in this group are those who have likely experienced the most severe impact physiologically and will therefore benefit from an earlier clinical review to detect issues at 4-6 weeks post discharge. This review may be remote where feasible. They should be offered a face to face review at 12 weeks post discharge rather than a virtual review.

- 2) **Patients with a mild to moderate clinico-radiological diagnosis of COVID-19 pneumonia who did not require ICU or HDU care – typically cared for on the ward or in the community. This group includes those discharged directly from the emergency department or medical assessment unit and not admitted despite a diagnosis of COVID-19 pneumonia (figure 2).**

Patients in this group are more likely to be able to wait for a 12 week virtual CXR review if recovering gradually in the community. It is anticipated that a significant proportion of this group will not require face to face or telephone contact.

General points regarding the follow up pathway

- If any inpatient radiological imaging is suspicious for lung malignancy, consider either an early repeat CXR at 6 weeks after hospital discharge to check for resolution OR referral to local cancer services for further assessment as clinically indicated.
- Patients with confirmed COVID-19 infection without radiological evidence of viral pneumonia or those whose radiology normalises by the time of hospital discharge do not need routine CXR follow up as per this guidance. Some of these patients however may require onward referral to rehabilitation services.
- Rehabilitation services are currently under national review after the COVID-19 outbreak and are expected to offer comprehensive assessments including psychosocial assessments. Where appropriate, for patients who prefer web based, self-directed rehabilitation at home further information is available [here](#).
- On discharge from hospital, all patients should be advised that if they develop progressive or new respiratory symptoms prior to their intended review date, they should seek medical attention either from their GP surgery or if appropriate by presenting as an emergency to hospital.
- At point of discharge, patients should be considered for early referral to rehabilitation services and for psychosocial support where appropriate.
- Any intended virtual steps in follow up plans should be explained to patients so they know what to expect. For patients discharged prior to the publication of this guidance, teams should consider (where feasible) contacting patients by telephone or in writing to advise them of follow plans. These strategies may reduce patient anxiety post discharge. On discharge, patients should be given general advice explaining that recovery from pneumonia to full health may take some weeks to months but that a clinical trajectory of improvement is reassuring.
- This pathway cannot cover, nor is it intended to cover, all aspects of possible care needs that may be discovered in a patient in their post COVID19 recovery period. As the recovery phase from COVID-19 is likely to be heterogenous and at times potentially unpredictable,

clinicians need to be vigilant for emerging issues. They should pursue in the usual way any other care needs or medical complications they identify. This may require additional investigations, blood tests or onward referrals that are not mentioned in this guidance.

- On seeing this pathway many colleagues will have valid and genuine concerns about how they might be expected to deliver it. The number of post COVID-19 pneumonia cases needing follow up nationally is high and due to the recent UK peak, will need to be delivered initially over a relatively short period of time. Thereafter, it is expected that numbers will plateau. For this reason, the pathway has been rationalised as much as it has been felt safe to do so without compromising quality and the ability to detect the early, medium and long term respiratory complications of the disease.
- Imaging follow up data from the previous SARS and MERS coronavirus outbreaks provide some data from which to model. At 12 weeks post-discharge, approximately 65% of these patients had full CXR resolution^{1,2}. If patients with COVID-19 pneumonia recover similarly, it is envisaged that only approximately one third of patients with mild to moderate COVID-19 pneumonia may need to proceed to Step 2 and be further assessed within the pathway (figure 2). Of those, a further proportion will be discharged at Step 2 without a need for cross sectional imaging and large elements of steps 1 and 2 may be delivered virtually. For severely affected patients (figure 1) the equivalent 'Steps 1 and 2' are combined in that a CXR will occur with a simultaneous clinical review due to the suspicion that this group are at higher risk of developing significant post COVID-19 complications.
- Safety netting has been embedded within the pathway. Those discharged at Step 1 in the mild to moderate group (figure 2) with a clear CXR will not have been reviewed face to face or had a telephone consultation. This cohort will receive a discharge letter informing them that their CXR changes have resolved. The letter will advise them to seek the advice of their GP Surgery or access emergency services as appropriate if they have new, persistent or ongoing significant symptoms. Clearly some of these patients may be referred in for further assessment. It is important to try and collect data on these referrals where possible so it can be established if the guidance has limitations so that it can be iterated. Patient numbers and the indication for referral would be valuable in this regard.
- The pathway can be 'enhanced' at appropriate time points for hospitals who have the resources to offer a more comprehensive follow up system. Virtual points in the pathway can, for example, be turned into face to face assessments or telephone consultations added in. Some centres may be able to offer early detailed rehabilitation and /or psychosocial assessments at these time points.
- It is advised that hospitals actively collect data on the number of patients who may require respiratory follow up. Teams should use this data to discuss the workforce needs to deliver their COVID-19 follow up programme with their Trusts.

- To facilitate later data analysis of COVID-19 pneumonia follow up, it is advised (where feasible) that this cohort go into separately named 'COVID-19 clinics'. This should be considered for both virtual and face to face work where possible.

Follow up pathways

1) Patients admitted for hospital care with a clinico-radiological diagnosis of COVID-19 pneumonia who required ICU or HDU admission or were cared for on the ward with severe pneumonia (Figure 1).

Due to their disease severity, these patients will require an early assessment at 4 – 6 weeks after discharge. These patients may include those with ongoing significant respiratory symptoms compared to normal, patients discharged with oxygen and those with acute rehabilitation, palliative care or psychosocial needs. Community teams where available may be able to assess patients at an earlier stage - for example by reviewing those in whom oxygen therapy can be weaned post-discharge.

- Ideally a remote or virtual clinic consultation by either a respiratory doctor or nurse should be conducted in the first instance. A face to face clinical assessment by either a respiratory doctor or nurse can then be arranged should a virtual consultation not be deemed sufficient or suitable to assess specific patients. This appointment should include a 'Post-COVID-19' holistic assessment which should at least include;
 - Assessment and management of breathlessness
 - Symptom or palliative care management where required
 - Assessment and management of oxygen requirements
 - Consideration of rehabilitation needs and onward referral where required
 - Psychosocial assessment and onward referral where required
 - Assessment and management of anxiety
 - Assessment and management of dysfunctional breathing
 - Consideration of a new diagnosis of venous thromboembolic disease (VTE)
- To avoid duplication of work streams, respiratory liaison with local ICU teams is recommended to coordinate respiratory follow up with dedicated post-ICU follow up which some units provide.
- Later, at approximately 12 weeks post discharge, all patients in this group should proceed to a face to face clinical assessment for:
 - CXR follow up
 - Assessment of symptoms
- If the CXR changes have fully resolved by this point (or if there are only minor insignificant changes such as small areas of atelectasis) and the patient has made a good recovery, consider discharge.

- In some cases, a patient will be clinically improving but the CXR may still have persisting changes that require further assessment. In this scenario, consider arranging a further CXR in 6-8 weeks to assess for clearance with remote or virtual follow up assessment by a doctor or a nurse prior to discharge if progress remains satisfactory.
- If the CXR has not cleared satisfactorily and/or the patient has ongoing respiratory symptoms, consider;
 - Full pulmonary function testing
 - Walk test with assessment of oxygen saturation
 - Echocardiogram
 - Sputum sample if expectorating for microbiological analysis
 - Assess need for referral to rehabilitation services if not already done
 - A new diagnosis of Pulmonary Embolism (PE) or post-PE complications if diagnosed during acute illness
- If there are persistent CXR changes and/or evidence of physiological impairment is found from investigations above, consider a pre-contrast high resolution volumetric CT and a CT pulmonary angiogram (CTPA) to assess for the presence of both interstitial lung disease and pulmonary emboli. It is pragmatic at this point to arrange a single scan to identify persisting parenchymal abnormalities as well as pulmonary vascular disease.
- If there is evidence of clinically significant interstitial lung disease (ILD) such as organising pneumonia or pulmonary fibrosis, patients should be considered for referral to Regional Specialist ILD services.
- Patients diagnosed with PE *de novo* during follow up should be treated as per agreed protocols and followed up in local services.
- If there is evidence of significant pulmonary hypertension (PH) during follow up, patients should be considered for referral to a specialist PH service.
- Patients diagnosed with PE during the acute illness should, where possible, be followed up in local clinics 12 weeks after discharge as per usual protocols.
 - If there is no suspicion of residual thromboembolic disease or evidence of significant pulmonary hypertension, patients should be considered for discharge from PE follow up with clear advice to GP about the intended length of anti-coagulation treatment.
 - Patients with evidence of significant PH or evidence of significant chronic thromboembolic disease with or without PH should be considered for referral to specialist PH services.
 - Any post COVID-19 pneumonia patient who is attending a post-PE follow up should have that visit coordinated with their pneumonia follow up review where possible. A CXR should be offered on arrival to assess for resolution. If

the CXR continues to show significant non-resolution, please consider further investigations as above.

- If there is evidence of physiological or functional impairment but no evidence of significant interstitial lung disease or pulmonary vascular disease other diagnoses should be considered and managed appropriately.
- If dysfunctional breathing is suspected, consider referral to specialist physiotherapy services.
- It is not intended that follow up appointments be offered within 'post COVID-19' follow up clinics. Where further investigations are requested, a virtual review and onward referral to appropriate services should be considered. If investigations are normal consider discharge. If onward care is required consider discharge back to GP, utilising community respiratory clinics where possible or transfer into usual general respiratory clinics where needed.
- Collecting data on the outcomes from this 12-week review will be important later in analysing the efficacy of this guidance.

2) Patients with a mild to moderate clinico-radiological diagnosis of COVID-19 pneumonia who did not require ICU or HDU care – typically cared for on the ward or in the community (Figure 2).

- Routine follow-up CXR (1st at Step 1) at 12 weeks from hospital discharge ideally in virtual clinic;
- If the 12-week follow-up CXR demonstrates complete resolution (or minor insignificant changes e.g. atelectasis) please send a standard discharge letter to patient and GP.
 - This letter should include clear advice to the patient to seek medical attention if they are experiencing new, persistent or progressive respiratory symptoms.
 - This patient is not intended to be reviewed face to face unless they subsequently self-present to hospital with symptoms or are referred by their GP.
 - It is expected that respiratory follow up for a significant number of post COVID-19 pneumonias will end here. Exact numbers will only be revealed over time however.
- For patients with significant persisting CXR abnormalities at 12 weeks consider requesting;
 - Full pulmonary function tests and arrange to see the patient in a face to face outpatient setting with results or arrange initial telephone consultation.

- When seen or assessed by telephone, if more than 6 weeks has passed since the 1st CXR at Step 1, consider repeating the CXR (2nd) on arrival to the outpatient setting as in some patients the abnormalities may have resolved between these two time points.
- If the 2nd CXR has cleared or has non-significant findings, radiological follow up ends. Consider discharging the patient if well and manage any pulmonary function test abnormalities. Reassess the need for referral to rehabilitation services.
- Patients with persistent significant abnormalities on the 2nd CXR and/or abnormal pulmonary function tests and/or significant unexplained breathlessness may require further investigations which might include;
 - pre-contrast high resolution volumetric CT and a CT pulmonary angiogram (CTPA) to assess for the presence of both ILD and PE.
 - Walk test with assessment of oxygen saturation
 - Echocardiogram
- In the event that specific abnormalities such as ILD or PH are identified, patients should be considered for referral to regional specialist services.
- Patients diagnosed with PE *de novo* during follow up should be treated as per protocols and followed up in local services.
- Patients diagnosed with pulmonary embolism during the acute illness should be followed up where possible in local clinics 12 weeks after discharge.
 - If there is no residual thromboembolic disease or evidence of pulmonary hypertension, patients should be discharged.
 - Patients with evidence of pulmonary hypertension or evidence of significant chronic thromboembolic disease with or without pulmonary hypertension should be referred to specialist PH services.
 - Any post COVID-19 pneumonia patient who is attending a post PE follow up should have that visit coordinated with their pneumonia follow up review where possible. A CXR should be offered on arrival to assess for resolution. If the CXR continues to show significant non-resolution, please consider further investigations as above.
- If there is evidence of physiological or functional impairment but no evidence of significant interstitial lung disease or pulmonary vascular disease other diagnoses should be considered and managed appropriately.
- If dysfunctional breathing is suspected, consider referral to specialist physiotherapy services.

- It is not intended that follow up appointments be offered within 'post COVID-19' follow up clinics. Where further investigations are requested a virtual review and onward referral to appropriate services should be considered. If investigations are normal consider discharge. If onward care is required consider discharge back to GP, utilising community respiratory clinics where possible or transfer into usual general respiratory clinics where needed.
- Collecting data on the outcomes from this 12-week review will be important later in analysing the efficacy of this guidance.

Managing workloads, virtual solutions and working cross speciality with colleagues to optimise work flows

- Where possible teams should opt for remote or virtual working with pre-ordering of tests prior to clinical reviews.
- Where possible, respiratory teams should liaise with ICU colleagues over early clinical reviews and also liaise with their radiology departments where possible to optimise workflows.
- It may be possible for some radiology departments to provide respiratory teams with a list of all COVID-19 pneumonia positive CXRs if they adopted a coding system such as the British Society of Thoracic Imaging (BSTI) COVID-19 radiological codes or a local alternative. This may be helpful in ensuring that all patients are contacted for follow up imaging as some patients will have been discharged from non-respiratory beds at the height of the outbreak. Please liaise with radiology colleagues where possible to adopt the most efficient way locally to organise 12-week follow up CXRs.

Frequently Asked Questions (FAQs)

a) Why is the recommendation for a routine post-COVID-19 viral pneumonia follow up CXR (step1) at 12 and not the standard 6 weeks as for a community acquired pneumonia?

- The main indication for the British Thoracic Society advice to repeat the CXR at 6 weeks after a community acquired pneumonia is primarily to exclude an underlying malignancy⁸. The American Thoracic Society (ATS) takes a different stance and recommends no routine follow up imaging for patients recovering satisfactorily from community acquired pneumonia.⁹
- The main indications to follow up radiological COVID-19 pneumonia are different and therefore allow us to consider a later follow up time point. Consideration has also been given to the current lack of routine outpatient radiology services during the current virus outbreak. The characteristic radiological features of COVID-19 pneumonia are less suspicious for harbouring a malignant lesion being more inflammatory and diffuse in nature. A later follow up time point will hopefully allow

more time for patients to improve clinically with resolution of CXRs and for radiology outpatients to regain their full capacity. Only those with non-resolving issues will then require further investigations. This will utilise resources more efficiently, ensuring investigation of those in whom it is required who may, for example, be at risk of developing longer term complications.

- Some will question the rationale for radiological driven follow up. It is felt however that patients who have full CXR resolution will benefit from knowing this and be reassured. There is also intent to learn more about COVID-19 pneumonia and its outcomes by applying this guidance. An analysis of the effectiveness of this guidance is intended at a later time point with modifications to advice as required.
- In addition, the 12-week follow up time point ensures a streamlined patient pathway to encompass post-PE follow up. There is a high incidence of thromboembolic disease in this patient group. At post-PE follow up clinics, a CXR should be requested on arrival to facilitate the post COVID-19 pneumonia radiological follow up at the same visit.
- Irrespective of the above advice, if lung malignancy is suspected in a COVID-19 pneumonia case consider a repeat CXR 6 weeks after hospital discharge to assess for resolution and/or refer to local cancer team if appropriate.

b) Why is there a separate follow up algorithm (figure 1) for patients requiring admission to intensive care units and those with severe COVID-19 pneumonia compared to those with mild or moderate disease (figure 2)?

- Patients admitted to ICU with SARS had significantly lower lung function (forced vital capacity (FVC), total lung capacity (TLC) and transfer factor of the lung for carbon monoxide (TLco)¹ than those cared for on general wards.¹
- It is possible that a proportion of COVID-19 ICU survivors will experience persistent physiological impairment and radiological abnormalities.
- Patients with severe COVID-19 pneumonia and those discharged with acute care needs are likely to be the most vulnerable and in need of more intensive medical, nursing, rehabilitation, psychological and social input. It is this group that is more likely to require earlier clinical review.
- Figure 1 has two specific differences to figure 2. Firstly it suggests an early assessment at 4-6 weeks post discharge for those who have experienced a more severe clinical course. Secondly it suggests a face to face clinical assessment at 12 weeks post discharge rather than a virtual CXR review offered to those who have experienced a mild or moderate clinical course. It is anticipated that this severe group are at highest risk of developing longer term complications. The pathway is designed to identify these up at the earliest reasonable time point. It is also anticipated in the mild to moderate group that a significant proportion will have made a reasonable recovery by 12 weeks and may not need further input. If a later analysis of the pathway

demonstrates these assumptions to be incorrect, the guidance can be modified. It is thus important that the efficacy of the pathway is assessed at a later date.

c) What is a 'Post- COVID-19 holistic assessment' of patient needs?

- It will be centrally important to assess the holistic needs of patients recovering from COVID-19.
- The 'Post-COVID-19' holistic assessment should at least include;
 - Assessment and management of breathlessness
 - Symptom or palliative care management where required
 - Assessment and management of oxygen requirements
 - Consideration of rehabilitation needs and onward referral where required
 - Psychosocial assessment and onward referral where required
 - Assessment and management of anxiety
 - Assessment and management of dysfunctional breathing
 - Consideration of a new diagnosis of venous thromboembolic disease (VTE)

d) Why follow up patients who were well enough to be discharged directly from the emergency department or medical assessment units and not admitted despite a diagnosis of COVID-19 pneumonia?

- COVID-19 disease is a new and as yet, unknown entity. We need to learn as much as we can about the outcomes post-infection. We do not know at this stage that patients who are discharged early or do not require hospital admission have a better longer term outcome and higher chance of radiological clearance. Using this guidance we hope to be able to answer this question. This may lead to modifications to the follow up guidance later. Until we know more we advise follow up assessment of this group to establish their recovery and wellbeing.

e) How should patients diagnosed with pulmonary emboli during the acute illness be followed up?

- There is an emerging signal for a high prevalence of pulmonary thrombotic disease in the most severely affected COVID-19 patients.⁶
- Patients diagnosed with pulmonary embolism during the acute illness should have post-PE follow up as per local protocols. Consider referral to Specialist PH services where appropriate if PH is suspected or significant chronic thromboembolic disease demonstrated. If there is no evidence of residual thromboembolic disease or pulmonary hypertension, the duration of anticoagulation is at the discretion of the treating team. Further detail is provided in the [BTS guidance on venous thromboembolic disease in patients with COVID-19](#).

Other considerations

- Integration with post-ICU clinics is important in ensuring that patient pathways are streamlined particularly for patients who required tracheostomy during their admission and may have ongoing care needs.
- Respiratory community teams will play an important part in the early care of patients discharged from hospital, for example when considering ongoing oxygen requirements, identification of rehabilitation needs, diagnosis of dysfunctional breathing and mental health assessment. Please liaise where possible.
- Respiratory services should where possible collate data on all patients assessed to allow participation in forthcoming nationally coordinated audits and research studies. More information regarding relevant data points will be released in the near future. It is important that the respiratory community rapidly learn as much as possible about COVID-19 and iterate the follow up guidance to maximally support patients, optimally use NHS resources and provide high quality care.
- Consider appropriate microbiological investigation to screen for bacterial or fungal co-infection.
- Patients may remain hypercoagulable for some time after the acute illness and there should be a low index of suspicion for acute thromboembolic disease during the follow up period.
- Cardiac, renal and neurological complications may be prevalent and so consideration of dedicated specialist follow up should be considered and where joint clinics exist, these should be utilised to streamline the patient pathway.

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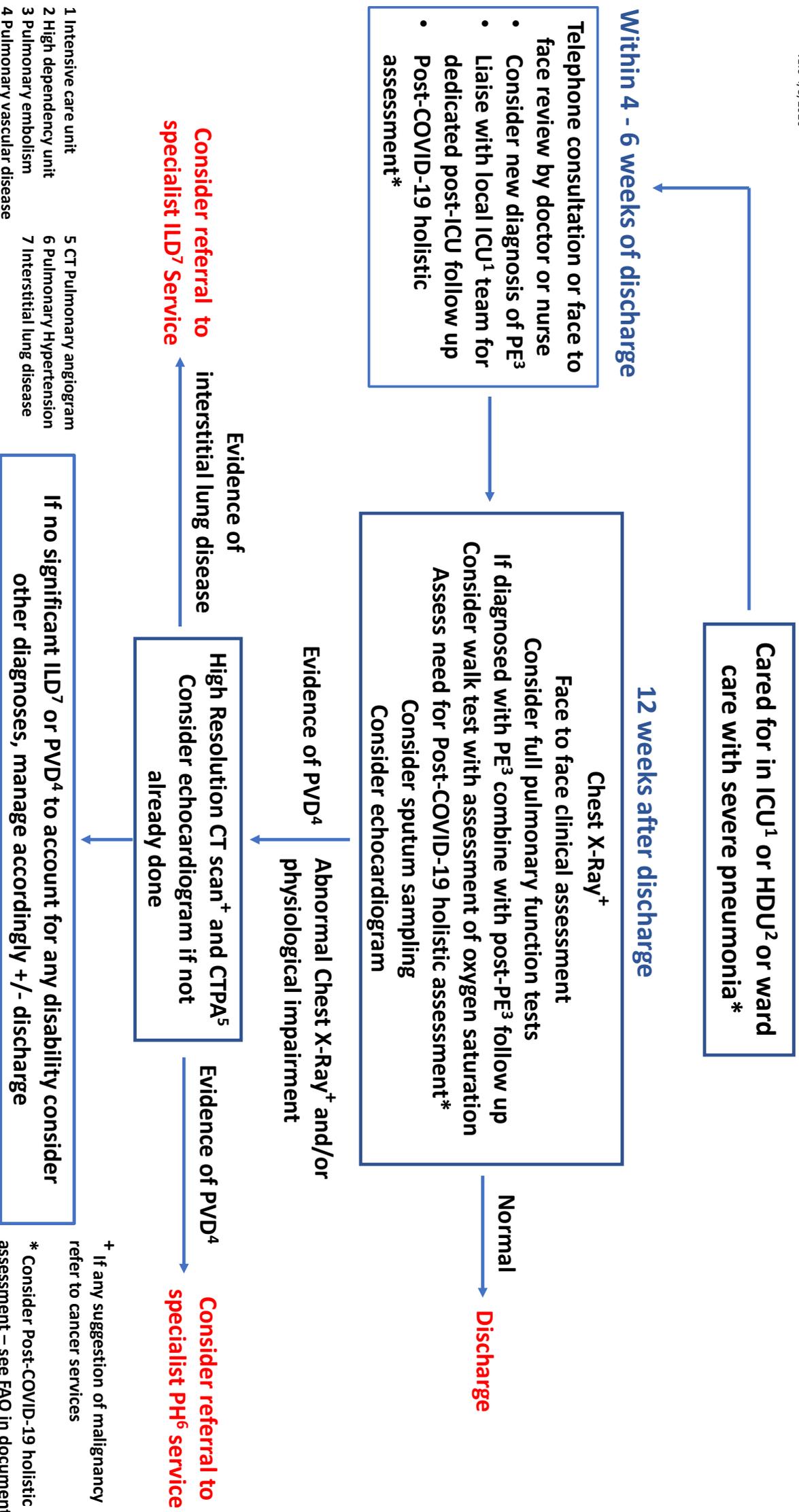
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Figure 1

Respiratory follow up of patients with COVID-19 pneumonia

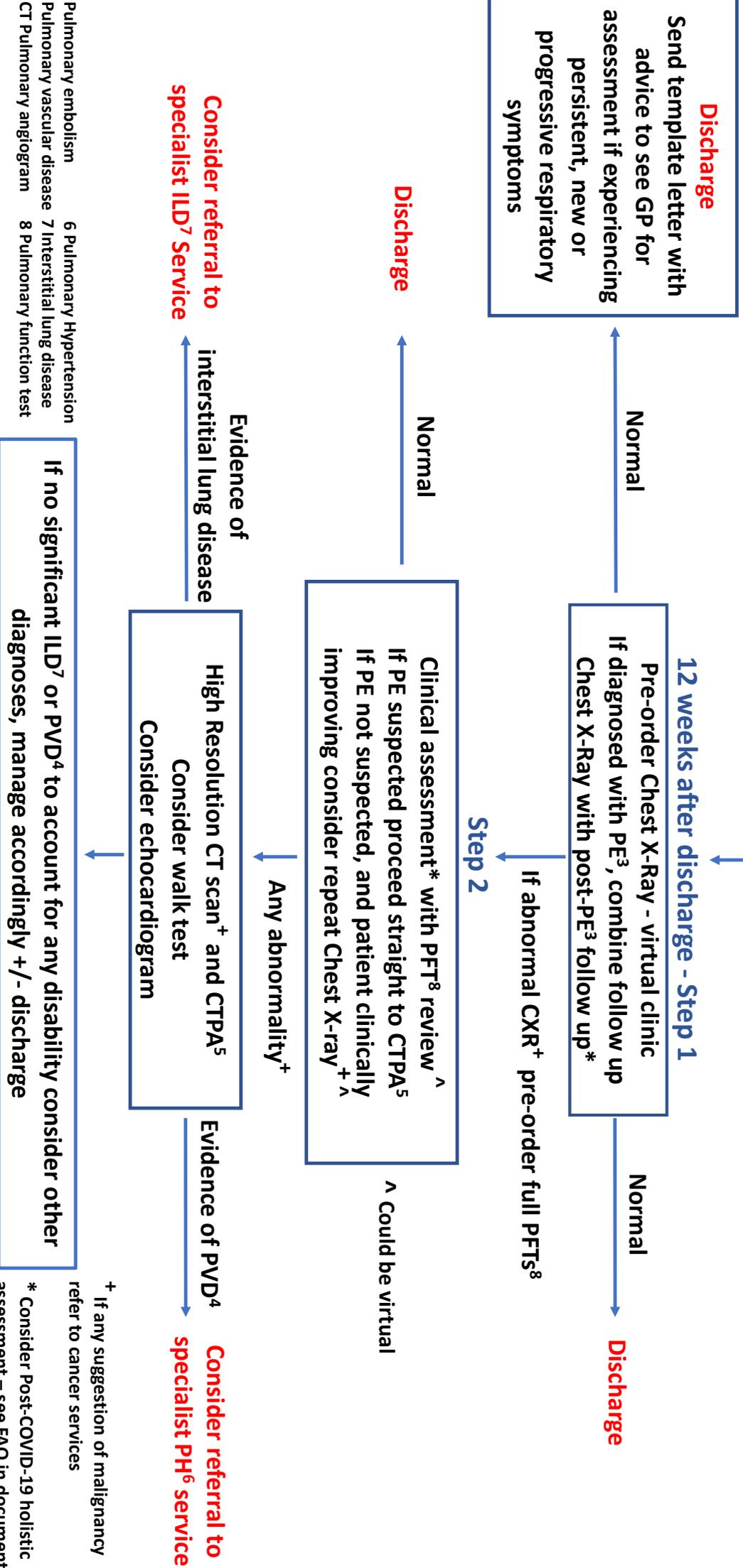


- 1 Intensive care unit
- 2 High dependency unit
- 3 Pulmonary embolism
- 4 Pulmonary vascular disease
- 5 CT Pulmonary angiogram
- 6 Pulmonary Hypertension
- 7 Interstitial lung disease

Respiratory follow up of patients with COVID-19 pneumonia

Figure 2

Mild to moderate pneumonia – typically cared for on ward or in community*



- 3 Pulmonary embolism
- 4 Pulmonary vascular disease
- 5 CT Pulmonary angiogram
- 6 Pulmonary Hypertension
- 7 Interstitial lung disease
- 8 Pulmonary function test