



## **Updated-UC San Diego Guidelines for Evaluation of Divers during COVID-19 pandemic**

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### ***Background:***

Coronavirus Disease 2019 (COVID-19) has become a global pandemic with SARS-CoV2 infecting millions of people and resulting in thousands of hospitalizations and deaths worldwide. Research examining the origins and structure of the virus, its pathogenesis, and the clinical features of its acute presentation is growing at a fast pace. However, as a nascent pandemic, the long-term sequelae to be expected in those who have survived the acute disease are largely unknown. SARS-CoV2 infection manifests primarily as atypical pneumonia, but in severe disease other complications are common, including cardiac and thromboembolic disease.

Scuba diving is a passion for many recreational divers, but, more importantly, it also represents a critical component of the commercial diving industry and scientific research. UCSD runs a diving medicine clinic that sees approximately 250 divers per year, most of whom are employed as commercial and scientific divers. As society begins to re-open after quarantines, many of these divers are presenting to our (and others') clinic requesting guidance and clearance on returning to dive after the pandemic.

### ***COVID-19 and Diving:***

We are presented with the challenge of performing fitness to dive evaluations in the context of a disease in which the natural history is still unknown, though more information is becoming available. In what we know of the pathophysiology of the disease, the pulmonary, cardiac, and thromboembolic/hypercoagulable disease seems to be relevant to divers. Potential long-term sequelae include decreased exercise tolerance, increased susceptibility to cardiac events such as heart failure, pulmonary edema, and arrhythmia, structural changes of the lung leading to increased risk for barotrauma, and increased risk of decompression sickness from underlying hypercoagulability.

We originally developed these guidelines in May of 2020 and the current landscape of the pandemic has significantly changed since that time. We have seen the development of vaccines that protect divers/people from infection, severe disease, and death. We have also witnessed the evolution of a virus into various strains, including some variants that are more contagious and some that seem to cause both more and less severe disease.

The situation has also changed significantly with the massive surge in cases due to the Omicron variant resulting in many divers who require rapid clearance to return to work. In addition, many only report symptoms like the common cold, which appear to be much milder than the original infection. In light of these developments, we recognized an amendment of our guidelines is needed.

The modifications to our guidelines were developed in a response to the challenges noted above and what we have observed clinically. In our experience, as well as information gathered from very limited publications, it appears that in cases where the disease causes only upper respiratory symptoms, there are limited long term sequelae or complications. We have also noted the

publication of multiple recent reports suggesting that a percentage of young and otherwise healthy patients who recover from mild or asymptomatic COVID-19 illness, may have surrogate findings of myocardial inflammation or damage on cardiac MRI. These findings are, however, of unclear clinical and prognostic significance. Our recommendations remain centered around the presence of cardiac symptoms or exercise limitations to guide further testing. Consequently, we have adjusted to treating such cases in a similar nature as we would other uncomplicated seasonal, upper respiratory viruses.

A few things should be noted-first, recommendations for those with moderate or severe disease have not changed. Second, as with our original guidelines, we strongly emphasize that these amendments are only applicable to those who have recovered from their acute illness, are completely asymptomatic, and back to their baseline exercise capacity.

Our goal has been to categorize divers based on the history and severity of their illness and base their return to dive evaluation accordingly. As with any illness, ultimately the work up is left to the discretion of the evaluating physician. Our plan is to continue to update them as we gain more experience and more evidence becomes available. The following guidelines are referring to divers who are ***completely asymptomatic*** after their illness, including exercise tolerance (see below). Before using the guidelines below, a few terms warrant definition:

*Definitions of terms used in guidelines:*

### ***COVID-19-suspected Illness***

We define a COVID-19-suspected illness as a diver who had symptoms consistent with COVID-19 with or without a positive PCR or rapid antigen, given that testing is still not universally available or reliable. We are currently using the CDC case definition (updated Aug 24, 2021) of COVID-19 for those patients who did not have PCR or rapid antigen confirmed illness:

In the absence of a more likely diagnosis:

- Acute onset or worsening of at least two of the following symptoms or signs:
- fever (measured or subjective),
- chills,
- rigors,
- myalgia,
- headache,
- sore throat,
- nausea or vomiting,
- diarrhea,
- fatigue,
- congestion or runny nose.

OR

- Acute onset or worsening of any one of the following symptoms or signs:
- cough,
- shortness of breath,
- difficulty breathing,
- olfactory disorder,
- taste disorder,
- confusion or change in mental status,
- persistent pain or pressure in the chest,
- pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone,
- inability to wake or stay awake.

OR

- Severe respiratory illness with at least one of the following:
- Clinical or radiographic evidence of pneumonia,
- Acute respiratory distress syndrome (ARDS).

### *Exercise Tolerance*

This is likely the most important definition used in our guidelines and it is vital that physicians evaluate it carefully. It is our belief that a diver with significant cardiac or pulmonary pathophysiology would not have a normal exercise tolerance. However, the definition of the word normal is critical. First, the diver must have returned to his or her baseline level of exercise and tolerance. Even minor deviations from their baseline (“getting more winded,” longer recovery times, etc) warrants further testing and investigation. Second, the physician must be satisfied that the diver’s exercise regimen warrants an appropriate exertional test for diving. There are no universally agreed upon recommendations on an exercise tolerance level needed for all divers, but the ADCI guidelines for commercial divers require a minimum level of 10 METS. If the physician is not convinced that the diver’s self-reported exercise level meets appropriate criteria or concerned that it would not reveal underlying cardiac or pulmonary disease, further testing is warranted.

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### ***Updated GUIDELINES FOR DIVER EVALUATION:***

<i>Category 0 NO history of COVID-19 suspected illness</i>	<i>Category 0.5 VERY MILD COVID-19- suspected illness</i>	<i>Category 1 MILD COVID-19- suspected illness</i>	<i>Category 2 MODERATE COVID-19- suspected illness</i>	<i>Category 3 SEVERE COVID-19-suspected illness</i>
<p>Definition: No history of COVID-19 or asymptomatic positive screening test</p>	<p>Definition:  <ul style="list-style-type: none"> <li>● <b>isolated upper respiratory or systemic symptoms (rhinorrhea/ congestion/ pharyngitis/ loss of taste or smell), fevers, fatigue, or myalgias but WITHOUT lower respiratory or cardiac symptoms.</b></li> <li>● Returned to baseline exercise tolerance.</li> </ul> </p>	<p>Definition:  <ul style="list-style-type: none"> <li>● <b>Symptomatic COVID-19 including any of the following: Any lower respiratory or cardiac symptoms, including chest pain, palpitations, significant* cough, shortness of breath with exertion or at rest.</b></li> <li>● outpatient treatment only without evidence of hypoxemia.</li> <li>● Did not require supplemental oxygen</li> <li>● Imaging was normal or not required</li> <li>● Returned to baseline exercise tolerance.</li> </ul> </p>	<p>Definition:  <ul style="list-style-type: none"> <li>● Required supplemental oxygen or was hypoxic</li> <li>● had abnormal chest imaging (chest radiograph or CT scan)</li> <li>● admitted to the hospital but did NOT require assisted ventilation (BIPAP, CPAP, or ventilator) or ICU level of care.</li> <li>● If admitted, had documentation of a normal cardiac work up including normal ECG and cardiac biomarkers e.g. troponin or CK-MB and BNP</li> <li>● Returned to baseline exercise tolerance.</li> </ul> </p>	<p>Definition:  <ul style="list-style-type: none"> <li>● Required mechanical or assisted (CPAP, BIPAP) ventilation, or ICU admission</li> <li>● Cardiac involvement defined as abnormal ECG, abnormal echocardiogram, or elevated cardiac biomarkers; e.g. troponin or CK-MB and BNP (or absence of documented work up)</li> <li>● Thromboembolic complications (such as PE, DVT, or other coagulopathy)</li> <li>● Returned to baseline exercise tolerance.</li> </ul> </p>

\*for example, cough that is productive, prevents from sleeping, or requires medication, ultimately defined at the discretion of the evaluating physician

Other factors may be taken into consideration including vaccination status, as there is evidence that breakthrough infections in those vaccinated against COVID-19 results in milder disease, and regional prevalence of variants (omicron vs delta, etc).

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<ul style="list-style-type: none"> <li>● Initial/annual exam per ADCI/AAUS /NOAA /RSTC guidelines</li> <li>● Chest radiograph only if required per ADCI/AAUS /NOAA/ RSTC guidelines</li> </ul> <p>No additional testing required</p>	<ul style="list-style-type: none"> <li>● Initial/annual exam per ADCI/AAUS /NOAA /RSTC guidelines</li> <li>● Chest radiograph only if required per ADCI/AAUS /NOAA/ RSTC guidelines</li> </ul> <p>No additional testing required</p>	<ul style="list-style-type: none"> <li>● Initial/annual exam per ADCI/AAUS/ NOAA /RSTC guidelines               <ul style="list-style-type: none"> <li>● Spirometry</li> <li>● Chest radiograph (PA &amp; Lateral) if abnormal, obtain Chest CT</li> <li>● If unknown (or unsatisfactory) exercise tolerance, perform exercise tolerance test with oxygen saturation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● Initial/annual exam per ADCI/AAUS/ NOAA /RSTC guidelines               <ul style="list-style-type: none"> <li>● Spirometry</li> <li>● Chest radiograph (PA &amp; Lateral) if abnormal, obtain Chest CT</li> <li>● ECG</li> <li>● Echocardiogram (if no work up was done as an inpatient. Can forgo if had negative work up)</li> <li>● If unknown (or unsatisfactory) exercise tolerance, perform exercise tolerance test with oxygen saturation</li> <li>● Investigation and management of any other complications or symptoms per provider and ADCI/AAUS/NOAA / RSTC guidelines</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● Initial/annual exam per ADCI/AAUS/ NOAA /RSTC guidelines               <ul style="list-style-type: none"> <li>● Spirometry</li> <li>● Chest radiograph (PA &amp; Lateral) (if abnormal, obtain Chest CT)</li> <li>● ECG</li> <li>● Repeat Cardiac troponin or CK-MB and BNP to ensure normalization</li> <li>● Echocardiogram</li> <li>● Exercise Echocardiogram with oxygen saturation</li> <li>● Investigation and management of any other complications or symptoms per provider and ADCI/AAUS/NOAA/ RSTC guidelines</li> </ul> </li> </ul>

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### ***Symptomatic divers or those with abnormal test results***

It is not currently our plan to allow divers who are symptomatic or have abnormal testing per the guidelines above to dive (though each will need to be evaluated on a case by case basis and exceptions are to be expected). However, we do not feel this necessarily represents a lifetime ban on diving as many of the sequelae which are currently disqualifying (such as abnormal CT scans) may resolve over the next 3-6 months and re-testing may be indicated. It is currently unknown whether or not potential sequelae of COVID-19 will become chronic and therefore re-evaluation will likely be indicated until more evidence becomes available.

### ***Screening of diving employees prior to diving***

We currently recommend following CDC guidelines for screening of an employee prior to diving and do not feel that measuring vital signs or oxygen saturation routinely before diving are warranted.