Lung Ultrasound in **COVID Patients**

Proposal for international standardization of the use of lung ultrasound for COVID-19 patients; a simple, quantitative, reproducible method (Soldati G, et al. J Ultrasound Med; 2020; doi: 10.1002/jum.15285)

COVID-19 pneumonia is characterized by alveolar edema with prominent proteinaceous exudates, vascular congestion, patchy inflammatory clusters with fibrinoid material, alveolar epithelial hyperplasia, and fibroblastic proliferation. These histopathologic changes provide a particular pattern of findings on lung ultrasound (LUS) that can help to differentiate COVID pneumonia from other causes of acute dyspnea.

LUS allows a bedside examination of patients, even those who are critically ill, without needing to transfer them. Thus, it could represent a valuable approach for the diagnosis and follow-up of lung involvement in COVID patients, minimizing the risk of further infection in healthcare personnel.

In particular, LUS can be used for:

1) triage of symptomatic patients at home or in the emergency room
2) prognostic stratification and monitoring of patients with COVID pneumonia
3) monitoring of ICU patients with ventilation
4) monitoring of therapeutic interventions

Since this global emergency needs a unified approach, Italian experts in LUS involved in the management of COVID-19 patients in different areas of Italy (Lucca, Trento, Rome, Pavia, Brescia, Voghera, Lodi) proposed a **standardized acquisition protocol and scoring algorithm**.

Acquisition Protocol (1/2):

- portable US, wireless probe, tablet
- all devices wrapped in single use plastic covers to reduce the risk of contamination and to facilitate the sterilization procedures
- 2 operators – one operator performing the examination, the second with tablet at safe distance from the patient
- convex or linear probes, according to the patient's body size
- single focal point modality (no multi-focusing), setting the focal point on the pleura line
- low mechanical index (MI) (start from 0.7 and reduce it further if possible), high MIs, if employed for a long observation time, may result in damaging the lung
- avoid saturation phenomena as much as possible by controlling the gain
- avoid the use of cosmetic filters and specific imaging modalities such as Harmonic Imaging, Contrast, Doppler, Compounding
- achieve the highest frame rate possible
- save the data in DICOM format

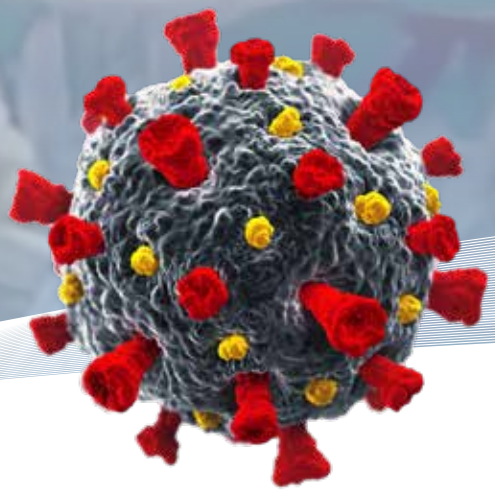
Acquisition protocol (2/2):

14 standard areas are proposed to be scanned in each patient, using landmarks on chest anatomic lines (see the scheme).

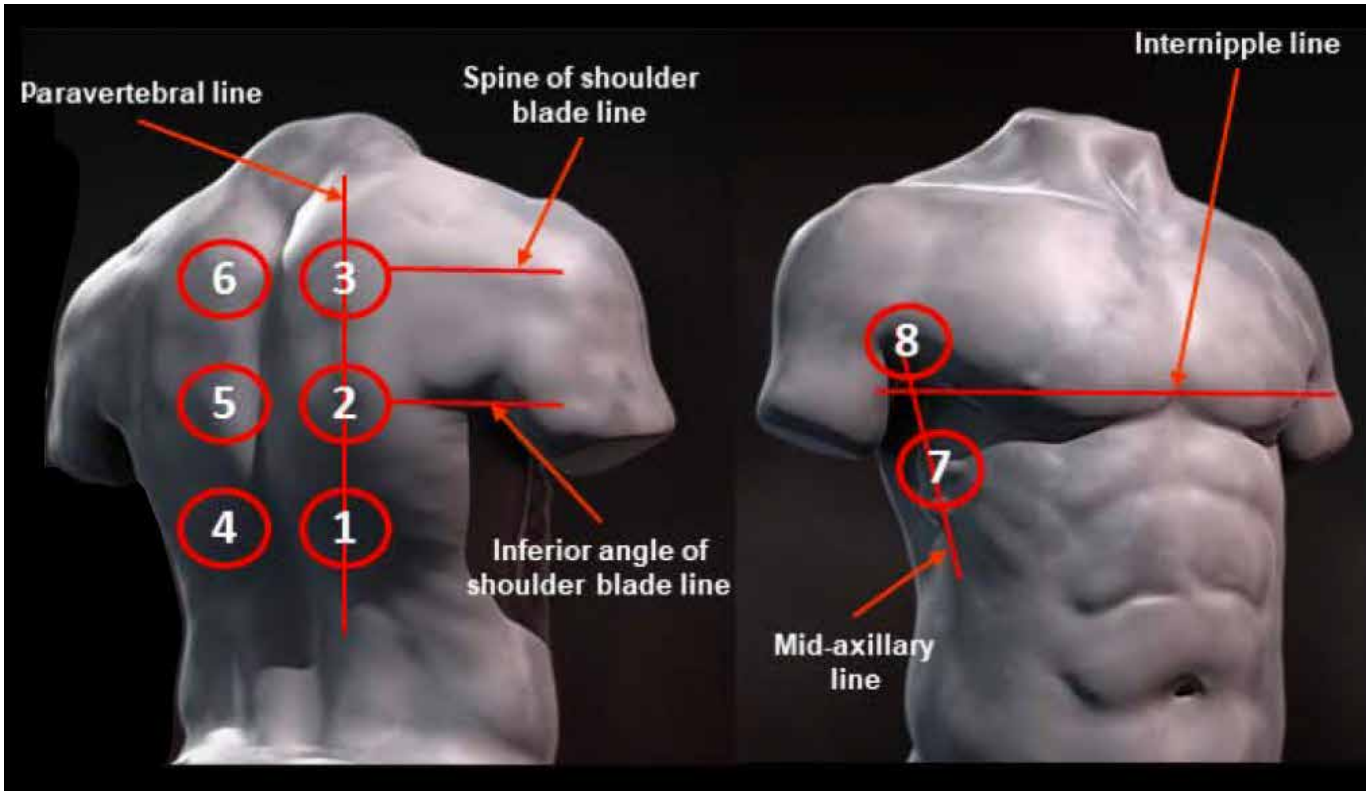
In patients able to maintain a sitting position:

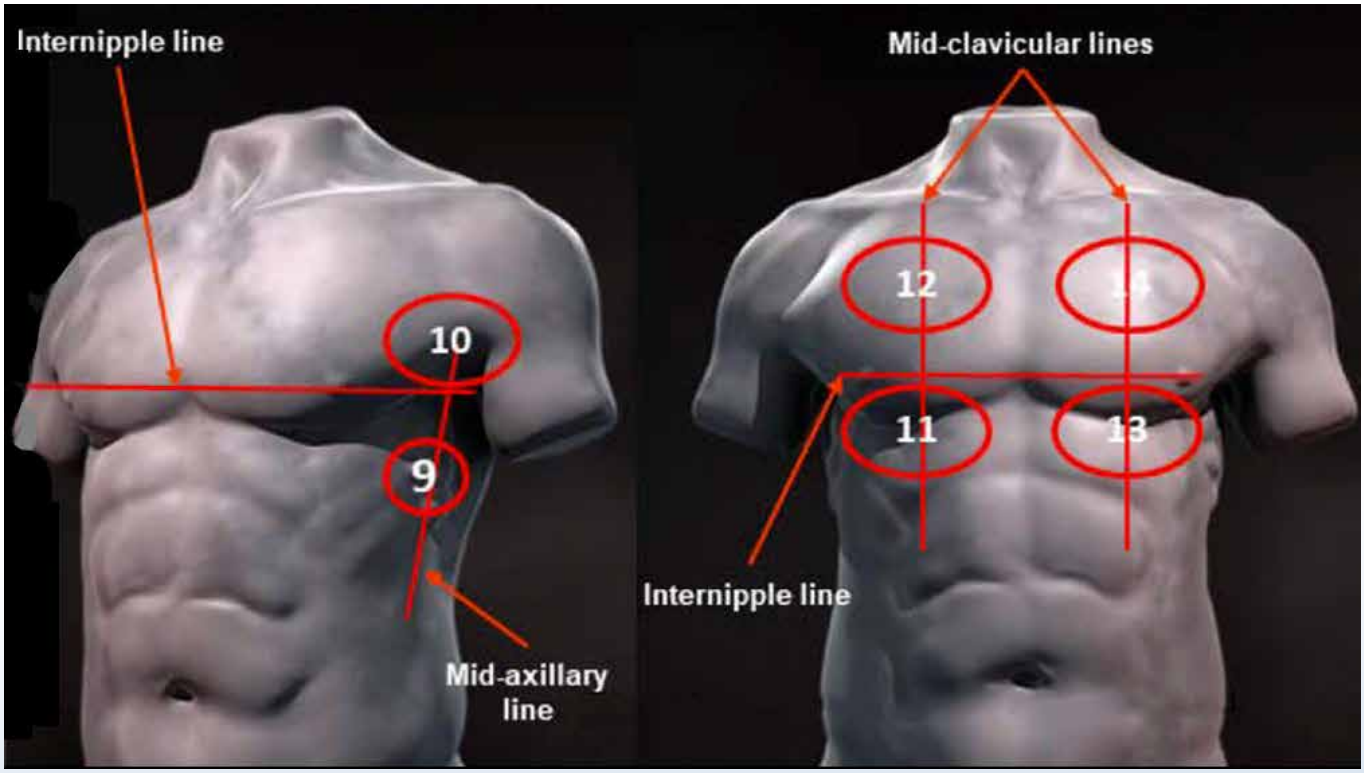
1. Right basal on paravertebral line above the curtain sign
2. Right middle on paravertebral line at the inferior angle of shoulder blade
3. Right upper on paravertebral line at spine of shoulder blade
4. Left basal on paravertebral line above the curtain sign
5. Left middle on paravertebral line at the inferior angle of shoulder blade
6. Left upper on paravertebral line at spine of shoulder blade
7. Right basal on mid-axillary line below the internipple line
8. Right upper on mid-axillary line above the internipple line
9. Left basal on mid-axillary line below the internipple line
10. Left upper on mid-axillary line above the internipple line
11. Right basal on mid-clavicular line below the internipple line
12. Right upper on mid-clavicular line above the internipple line
13. Left basal on mid-clavicular line below the internipple line
14. Left upper on mid-clavicular line above the internipple line

In patients on invasive ventilation and in patients that are not able to maintain a sitting position, the posterior areas might be difficult to be evaluated. In these cases, the operator should try to have a partial view of the posterior basal areas and start echographic assessment from landmark number 7.

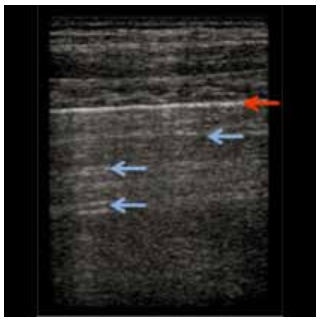


Proposed Areas for **Lung Scanning**

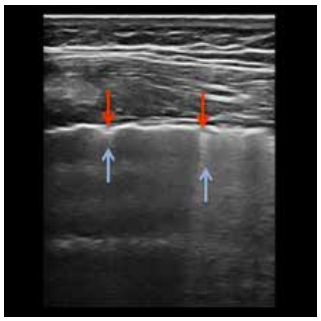




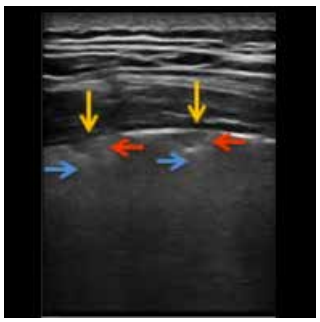
Scoring of findings



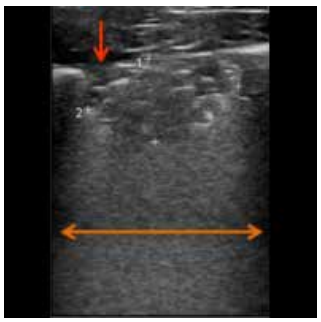

Score 0
The pleura line is continuous, regular and horizontal artifacts (A-lines) are present.




Score 1
The pleura line is indented and below the indent are visible vertical areas of white, which reflect local alterations in the acoustical properties of the lung caused by a replacement of air by water, blood, or fibrous tissue.




Score 2
The pleura line is broken; below the breaking point are small to large consolidated areas (darker areas) associated with areas of white. The darkening of the consolidated areas indicates the loss of aeration; white areas indicate the presence of air embedded in tissue like material.




Score 3
The scanned area shows dense and largely extended white lung with or without consolidations.

At the end, the physician indicates the highest score obtained for each area.

International database for data storage, image analyses, artificial intelligence studies

The authors of the article encourage the scientific community to embrace the development of a protected, internationally available database that allows the upload of images and videos of COVID-19 patients (X-ray, ultrasound, and CT scan).

This will speed the development of dedicated pattern recognition algorithms able to recognize COVID-19 related pathological findings, allow for the comparison between different centers, and foster the development of telemedicine programs (including remote evaluation of images, clinical advice, and case discussions) and telematic teaching programs.

https://covid19.disi.unitn.it/iclusdb

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Our best proposal to fight **against Covid-19**

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Low-frequency probe to scan lung parenchyma and commonly used in emergency for abdominal organs

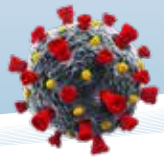
High-frequency probe to scan pleural area and superficial structures. Commonly used to scan vessels and support line placement

Low-frequency phased-array probe to scan the lung and commonly used for heart functionality monitoring

System/Transducer cleaning & disinfection: Dedicated guidelines developed to avoid cross-contamination of patients or staff

Bibliography

Proposal for international standardization of the use of lung ultrasound for COVID-19 patients; a simple, quantitative, reproducible method. Soldati G, Smargiassi A, Inchingolo R, Buonsenso D, Perrone T, Briganti DF, Perlini S, Torri E, Mariani A, Mossolani EE, Tursi F, Mento F, Demi L *J Ultrasound Med. 2020 Mar 30. doi: 10.1002/jum.15285.*



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