

COVID-19 and lung ultrasound: reasons why pediatricians can support adult COVID-19 unites during critical epidemiologic periods

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Abstract

The massive raise of COVID-19 cases all over the world is leading to unprecedented pressures on healthcare services. Growing evidence is highlighting that COVID-19 is a systemic condition that requires doctors with multiple expertise. Paediatricians are trained in these skills. Considering the issue of staff shortage that is facing every country in the world, and the complexity of COVID-19, paediatricians may represent an important source of ready and skilled specialists that can quickly translate the paediatric practice in the COVID-19 care. We report our experience by making several parallels between the paediatric clinical practice and clinical conditions described in patients with COVID-19 with particular reference to the use of lung ultrasound in paediatric clinical practice and in that of adult COVID-19 units.

COVID-19 and lung ultrasound: reasons why pediatricians can support adult COVID-19 unites during critical epidemiologic periods

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Abstract

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Growing evidence is highlighting that COVID-19 is a systemic condition that requires doctors with multiple expertise. Paediatricians are trained in these skills. Considering the issue of staff shortage that is facing every country in the world, and the complexity of COVID-19, paediatricians may represent an important source of ready and skilled specialists that can quickly translate the paediatric practice in the COVID-19 care.

We report our experience by making several parallels between the paediatric clinical practice and clinical conditions described in patients with COVID-19 with particular reference to the use of lung ultrasound in pediatric clinical practice and in that of adult COVID-19 units.

Since the beginning of the SARS-CoV-2 spread outside China, as well as several hospitals have changed their organization in order to increase critical care capacity and isolation areas to COVID-patients, and to generate new flows to guarantee safety and care also to non-COVID patients, also pediatric practice has changed completely.

SARS-CoV-2 is rarely involving children, and most of the time pediatric COVID-19 disease is mild.¹ Moreover, parents stopped to routinely bring their children to the hospital either because of fear in contracting the infection or due to a lockdown-related drop of seasonal infectious diseases.²

As a consequence, the workload of pediatricians has significantly reduced in these months³ and therefore their inclusion in COVID-19 units should be considered by Institutions.

Although not directly involved in adult care, pediatricians may play a significant role in managing COVID-19-like patients for several reasons (Table 1).

From a clinical point of view, pediatricians routinely take care of patients with viral conditions and acute respiratory distress (e.g. bronchiolitis, asthma) and that's why are confident in diagnosis and treatment. The usual management of these situations provide expertise in blood-gas analysis evaluation and in the use of devices for respiratory support, such as high-flow nasal cannula and continuous positive airway pressure (CPAP). In addition, recent evidence is pointing out that adult COVID-19 resembles systemic inflammatory syndromes⁴ and pediatricians are not new to such conditions. For instance, Kawasaki disease is one of the most common systemic conditions in children and, not rarely, biological agents are required to treat it, not to mention the new identity of pediatric inflammatory multisystem syndrome temporally associated with COVID-19 (PIMS-TS).⁵ Similarly, macrophage activation syndromes, as well as other rheumatologic conditions, do occur in secondary and tertiary level settings increasingly requiring from pediatricians to be trained in managing biological agents.

In the last years, in several pediatric settings, lung ultrasound (LUS) has become the first-line imaging method in children evaluated for respiratory disease, allowing the real time diagnosis and monitoring of lung involvement.⁶⁻¹³

In recent years, several studies have shown that LUS is a useful and accurate tool for detecting pneumonia in children and it may be better than chest radiography in the diagnosis of community-acquired pneumonia.^{6-9,13} Studies are showing that LUS is able to predict more severe pneumonia, monitor antibiotic response and,

recently, different LUS patterns have been able to differentiate viral from bacterial pneumonia by defining their etiology.^{6,9,13}

Many studies have described and validated LUS scores (based mainly on vertical artifacts and subpleural consolidations) in neonatal respiratory disorders¹⁰ and bronchiolitis.^{11,12}

For the development of lung ultrasound studies on the pediatric population but also for the development of the use of LUS in pediatric clinical practice, over the years it has been fundamental not only the references to studies performed on adults^{14,15} and therefore the translation in the clinical pediatric practice of knowledge acquired from these studies; but a true collaboration between pediatric specialists and specialists of the adult population was also fundamental, especially for the interpretation of some ultrasound findings such as in the case of vertical artifacts and ultrasound interstitial syndrome.^{7,14,15}

Since the outbreak of the pandemic, this sharing/collaboration of experiences and studies has assumed an ever greater force that takes shape every day in daily clinical practice in the fight against COVID-19.

In particular, it is not a coincidence that a pediatrician was the one who suggested to the medical community to use ultrasound more frequently in suspected COVID-19 patients and also the one who described the first case.¹⁶⁻¹⁸

Since then, LUS has played a key role in the management of patients with COVID-19 pneumonia.

Importantly, the ultrasound patterns of viral pneumonia and bronchiolitis in children are similar to those seen in COVID-19 pneumonia, such as pleural line irregularities and vertical artifacts (B-lines) with patchy distribution, sub pleural consolidations and white lung areas, making easier for pediatrician to detect pathological LUS patterns in adults (Figure 1).

Furthermore in general, the basic LUS semeiotics of COVID-19 pneumonia does not differs in adults and children.¹⁹⁻²¹

In order to allow comparing the severity of COVID-19 pneumonia of different patients, limiting the subjectivity and the operator-dependence of the exam, the standardization of the ultrasound semiotics of COVID-19 pneumonia and the LUS score of severity of COVID-19 pneumonia, have been proposed, and in the drafting of which a pediatrician (D.B.) actively participated.¹⁹⁻²⁰

Although they could face several limits dealing with adult patients, the habit to manage complex patients with multi-systemic diseases and poli-pharmacological therapies gives to pediatricians an important source of strength to contribute to the management of adult COVID-19 patients.

Probably all these strengths could also reduce the anxiety, stress and feeling of uncertainty that doctors who find themselves working in a different field from which they were trained can feel.

On the other hand, the major barrier could be represented by medico-legal concerns, as common comorbidities and complications of adult patients are far from the pediatric daily practice. A safe and effective strategy for COVID wards could be once again a multidisciplinary team. A close collaboration between pediatricians and internists (even mixing more and less experienced doctors) could be precious to re-introduce the former to adult patients and to ensure mutual clinical support.

In Bologna two internists, two pediatricians (including L.P.), one endocrinologist and a group of mixed pediatric and internist residents managed a 30-beds COVID ward.

In Rome, a pediatrician (D.B.) became responsible for LUS evaluation of pregnant women with respiratory conditions, in order to reduce the routine use of chest X-rays and computed tomography scans in this specific group, reserving these tools to selected cases.^{22,23}

The past, current and projected scale of distress among healthcare professionals, while understandable, has been and is of grave concern.⁹ The short- and long-term negative effects of this disease have the potential to have both physical and psychological consequences impacting significantly on the quality of life of both

of the health worker and their family. The existing risks to the well-being of healthcare professionals are compounded under the current highly pressurized conditions.²⁴

Concomitantly, the whole world is facing a severe shortage of Personal Protective Equipment³, which contributes to the high number of infections, disease and deaths among healthcare workers worldwide. Altogether, these factors determine an increasing shortage of doctors worldwide, including the richest countries.

Having adequate numbers of health workers and obtaining the collaboration among different specialists for whom less uncomfortable conditions possible are desired, will be critical to winning the battle against COVID-19.

Growing evidence is highlighting that COVID-19 is a systemic condition that requires doctors with multiple expertise²⁵: general support measures, experience in managing antivirals, antibiotics and biological agents, respiratory support, imaging interpretation and experience in point-of-care ultrasound. Pediatricians are trained in these skills, especially certain categories, i.e. those who deal with child pathologies globally (such as primary care pediatricians, first aid pediatricians, pediatricians in general pediatrics wards, pediatric intensive and sub-intensive therapy pediatricians) or infectious disease pediatricians and bronchopulmonary pediatricians.

Considering the issue of staff shortage that is facing every country in the world, the complexity of COVID-19, the rare and mild involvement of SARS-CoV-2 in children¹ and the reduced access to pediatric health facilities², the pediatricians may represent an important source of ready and skilled specialists that can quickly translate the pediatric practice in the COVID-19 care.

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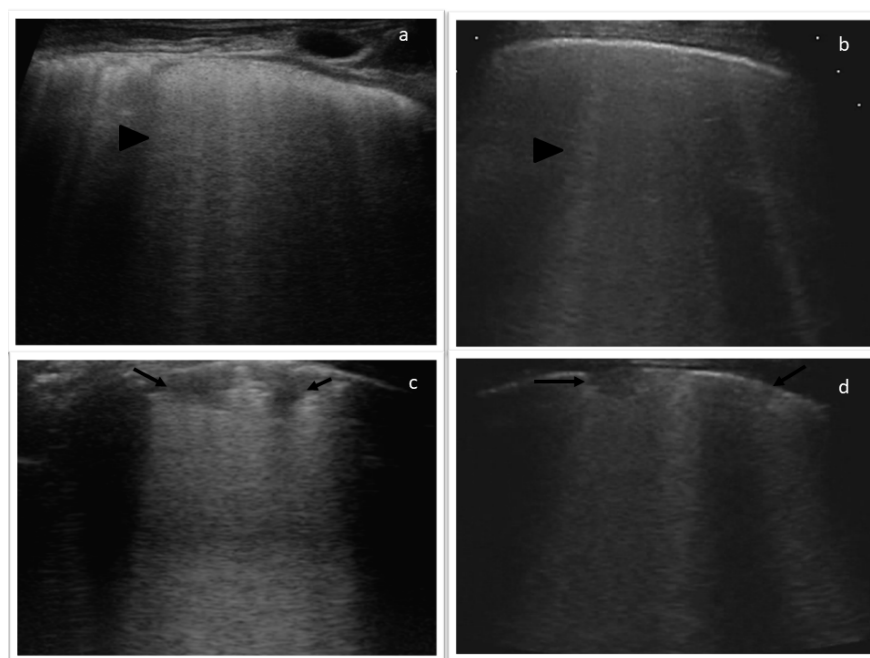
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Figure legend

Figure 1 Lung ultrasound findings in children with viral lower respiratory tract infection (a, c) and in a woman with COVID-19 pneumonia (a, d), performed by the same pediatrician.

1a Lung ultrasound images of a 4 year old boy with viral pneumonia - due to Coronavirus (non-COVID-19), Bocavirus and Metapneumovirus coinfection- requiring respiratory assistance with High-flow nasal oxygen at the pediatric department; ; lung ultrasound shows areas of white lung with multiple, coalescent vertical artifacts (B-lines, black arrowhead). A similar lung ultrasound pattern (multiple vertical artifacts, B-lines,

black arrowhead) was found in a 42 years old woman with COVID-19 pneumonia and moderate respiratory distress (**1b**). **1c** Lung ultrasound images of a 2 year old boy with H1N1 Influenza pneumonia requiring respiratory assistance with High-flow nasal oxygen at the pediatric department, showing subpleural consolidations (hypoechoic areas, black arrow) and below areas of white are evident. A similar lung ultrasound pattern (subpleural consolidations - black arrow – with areas of white lung) was found in a 31 years old pregnant woman with COVID-19 pneumonia and acute respiratory failure requiring admission in the intensive care unit (**1d**).



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