Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

COVID-19 pneumonia and the appropriate use of antibiotics

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Talking about COVID-19 has become a ritual for everyone. The COVID-19 pandemic has put respiratory illness—infection, pneumonia, and death—in the daily headlines. Many of us have been anticipating and dreading the next global respiratory pandemic. 2019 marked a century since the end of the 1918 H1N1 influenza A pandemic, and many marvelled at the fact that we had made it 100 years without a similar occurrence. Although there have been other global pandemics since, the 1918 influenza pandemic stood out in that it lasted over a year, infected about a third of the world's population, and killed more than 50 million people.

The deadly nature of H1N1 might be partly explained by bacterial superinfections. Abundant data show that the majority of deaths caused by influenza during the 1918 pandemic were attributable to secondary bacterial pneumonias.[1,2] When a preceding viral infection such as influenza or COVID-19 impairs both innate and adaptive antibacterial host defences, *Streptococcus pneumoniae*, *Staphylococcus aureus*, or other colonising bacteria exploit this temporary compromise of a physical and immunological barrier to cause secondary bacterial pneumonias, leading to severe and deadly disease in people with pre-existing comorbidities and previously healthy people. Data regarding bacterial superinfections in COVID-19 pneumonia are still emerging, but an association has been made between the detection of bacterial products in blood with disease severity in COVID-19 patients.[3] Diagnosing coinfections is complex in the best of circumstances and because there is a desire to avoid diagnostic procedures and minimise the exposure of COVID-19 to health-care workers, diagnosing potential bacterial superinfections during COVID-19 has been challenging.

Biomarkers associated with COVID-19 severity might be useful in predicting prognosis. Hyperinflammation plays an important role in COVID-19 disease progression, and an inflammatory cytokine storm can increase the severity.[3] Although many serum biomarkers lack specificity, increased procalcitonin concentrations have been investigated as a specific bacterial differentiation from viral response to bacterial respiratory tract infection.[4,5] From accumulating data and reports, there appears to be a clear association between elevated concentrations of procalcitonin and increasing COVID-19 disease severity, despite a variety of cutoffs chosen.[6,7]

Most bacterial pneumonias caught early enough can be safely and effectively treated with antibiotics, and broad-spectrum antibiotics are being widely used in patients with COVID-19.[8] However, antibiotic use drives the emergence of antibiotic-resistant bacteria. Antimicrobial resistance is not just an existential threat, it is another global pandemic with millions of antibiotic-resistant infections and more than 700 000 deaths each year. In 2019, the UN Interagency Coordination Group on Antimicrobial Resistance warned that by 2050, antibiotic-resistant diseases could cause 10 million deaths each year and can cause damage to the economy so catastrophic that, by 2030, antimicrobial resistance could force up to 24 million people into extreme poverty. There are concerns that an increase in antibiotic use during the COVID-19 pandemic could exacerbate the current global pandemic of antimicrobial resistance. However, when faced with patients who are critically ill and hospitalised, and the diagnosis of a potential bacterial superinfection is uncertain, health-care providers will and should err on the side of treating with broad-spectrum antibiotics, both as directed and empirical therapy. Adherence to established antibiotic stewardship programmes has declined as providers struggle to save the lives of patients with COVID-19.

Antibiotics save lives. Access to antibiotics is crucial and despite the increasing antibiotic consumption, paradoxically, many people in resource-constrained settings do not have access to antibiotics. The lack of access to antibiotics kills more people than antibiotic resistance.[9] The key to addressing the issues of antimicrobial resistance while ensuring access to lifesaving antibiotics is evaluating the appropriate use of antibiotics for the treatment of pneumonia. However, defining what appropriate means remains problematic given the ongoing substantial challenges in diagnosing pneumonias. In the case of COVID-19, better understanding and predicting COVID-19 disease severity, which can help guide treatment and management decisions, are essential to effectively combatting this deadly respiratory pandemic. There are calls for a multitiered, COVID-19 diagnostic strategy incorporating rapid, point-of-care host immune testing to identify

patients at risk of disease and progression.[10] This type of platform could be used for current and future pandemic planning. Being able to reliably and expeditiously identify the risk of disease and progression, in which infected patients with COVID-19 will develop severe pneumonia and disease, could help clinicians in risk stratifying patients and ensuring appropriate care and resources are available.

In observance of World Pneumonia Day on November 12, raising awareness of the need for increased research and development of diagnostics and prognostics around COVID-19 specifically, and pneumonia broadly, are warranted. Antibiotics have probably saved thousands of lives among severely ill COVID-19 patients—a therapy that was not available during the 1918 H1N1 influenza pandemic.

We declare no competing interests.

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