Technoleg Iechyd Cymru
Health Technology Wales

Topic Exploration Report

Topic explorations are designed to provide a high-level briefing on new topics submitted for consideration by Health Technology Wales. The main objectives of this report are to:

1. Determine the quantity and quality of evidence available for a technology of interest.
2. Identify any gaps in the evidence/ongoing evidence collection.
3. Inform decisions on topics that warrant fuller assessment by Health Technology Wales.

Topic:	**Point-of-care lung ultrasound imaging for suspected and confirmed cases of COVID-19**
Topic exploration report number:	**TER211**

Introduction and aims

Lung ultrasound devices can be used at the patient's bedside by a trained clinician. These devices are also known as point-of-care ultrasound devices (POCUS) and can be hand-held or cart-based.

In addition to supporting the initial diagnosis of COVID-19, lung POCUS is being used internationally to monitor hospitalised COVID-19 patients and guide decisions about prone ventilation, extracorporeal membrane oxygenation, and weaning from mechanical ventilation in acute respiratory failure.

It is widely agreed that computed tomography (CT) scans are the gold standard imaging technique for thoracic evaluation. However, they are associated with radiation exposure, concerns related to infection risk and the transportation of the critical patient. Lung POCUS devices are portable and can easily be performed at the bedside. They also have fewer infection-control implications. Stethoscopes and chest radiographs are the other main alternatives, but stethoscopes present a high risk of nosocomial transmission. Evidence suggests that CT scans and lung ultrasonography are superior to standard chest radiography for evaluation of pneumonia/pneumonitis and/or adult respiratory distress syndrome (The British Medical Ultrasound Society. 2020).

Home isolation is recommended for patients with COVID-19 with stable clinical presentations to avoid hospitalisation and minimise spread of the disease. Some ultrasound manufacturers have added tele-ultrasound software that allows remote training of novice POCUS users and remote guidance in actual patient care. Tele-ultrasound can be utilised to share images in real time with consultants or expert providers (Mathews et al. 2020).

Health Technology Wales researchers searched for evidence of the clinical and cost effectiveness of lung ultrasound, including POCUS, in any setting for the diagnosis of COVID-19 in people with suspected disease, and the monitoring of respiratory function in people with confirmed COVID-19. We also searched for evidence on the effectiveness of lung ultrasound, including POCUS, in the diagnosis and management of pneumonia, as pneumonia can be a complication of COVID-19.

Summary of evidence

Secondary evidence

UK guidance

The National Institute for Health and Care Excellence (NICE. 2020) produced a COVID-19 rapid guideline on antibiotics for pneumonia in adults in hospital. They recommended that chest imaging (X-ray, CT or ultrasound) can be considered to help inform decision-making about using antibiotics, and help inform the overall clinical assessment and decision about when to safely stop antibiotics. The NICE guideline did not make specific reference to POCUS.

Intensive Care Society Guidance (2020) on lung ultrasound in COVID-19 states that lung POCUS demonstrates a particular pattern of findings that can help differentiate it from other causes of acute dyspnoea. The guidance states that lung POCUS can facilitate the early identification of patients who may have COVID-19. This may have benefits in terms of patient triaging and early routing of patients to the appropriate location. The guidance also recommends that lung POCUS could be used to assist with deciding on ventilation strategies, and monitoring of lung fluid balance.

The British Medical Ultrasound Society (2020) states that POCUS may be of assistance during the COVID-19 pandemic, particularly in clinical triage.

Systematic reviews

Evidence for lung ultrasound in conditions other than COVID-19

We did not identify any systematic reviews studying lung ultrasound in COVID-19.

We identified numerous systematic reviews with meta-analyses investigating the diagnostic accuracy of lung ultrasound in the healthcare setting in children with suspected pneumonia. A meta-analysis by Tsou et al (2019) (n = 3,353) found that lung POCUS accurately diagnosed pneumonia in children, with an overall sensitivity of 94% (95% confidence interval [CI]: 89 to 97%) and specificity of 92% (95% CI: 0.78 to 0.98). Meta-regression revealed a significant difference in the diagnostic accuracy for pneumonia for lung POCUS between novice and advanced sonographers, with more experienced sonographers having higher diagnostic accuracy ($p < 0.01$). Heuvelings et al. (2019) conduced a meta-analysis of 18 pneumonia studies, comprising 2,031 children. They reported a sensitivity of 95.0% (95% CI: 90.7 to 97.3%) and specificity of 96.1% (95% CI: 89.1 to 98.7%), and concluded that chest ultrasound should be considered as a first-line imaging modality for children with suspected pneumonia. The study did not specifically mention POCUS.

We also identified numerous systematic reviews investigating the diagnostic accuracy of lung ultrasound in the healthcare setting in adults with suspected pneumonia. Staub et al (2019) systematically reviewed the accuracy of lung ultrasonography for the emergency diagnosis of pneumonia, acute heart failure, and exacerbation of chronic obstructive pulmonary disease/asthma. In patients suspected to have pneumonia, consolidation had a sensitivity of 82% (95% CI: 74 to 88%) and specificity of 94% (95% CI: 85 to 98%). The authors concluded that lung ultrasound is an accurate tool for the emergency diagnosis of pneumonia, acute heart failure, and exacerbations of COPD/asthma. Long et al (2017) included 1,515 participants in their meta-analysis. The sensitivity and specificity were 88% (95% CI: 86% to 90%) and 86% (95% CI: 83% to 88%), respectively, and they concluded that lung ultrasound can help to diagnose adult pneumonia with high accuracy. These studies did not specifically mention POCUS.

Health Technology Wales researchers also identified a meta-analysis reviewing the accuracy of lung POCUS in determining the need for surfactant treatment or mechanical ventilation in 485

infants with respiratory distress treated with nasal continuous positive airway pressure. The authors concluded that lung ultrasound, particularly lung ultrasound score, can be used to accurately determine the need for surfactant replacement treatment or mechanical ventilation in these infants (Razak and Faden. 2020).

Evidence for remote lung ultrasound

We identified a systematic review investigating the use of lung POCUS in non-traditional healthcare settings. The review supported the utility of lung ultrasound examinations when performed by skilled operators in austere environments. They concluded that implementation of POCUS protocols could aid in the rapid diagnosis, triage, and treatment of conditions such as pulmonary injury and illness among spaceflight participants (Johansen et al. 2018).

Primary evidence

Evidence for lung ultrasound in COVID-19

There is a lack of primary evidence for lung ultrasound in COVID-19. The topic proposer published a narrative review investigating the evidence for lung POCUS in patients with COVID-19 (Smith et al. April 2020). The review identified five letters, two case reports, three clinical recommendations, and a small case series. In addition to the publications identified in the topic proposer's narrative review, we identified a letter by Scheier (2020) arguing against the use of lung POCUS in COVID-19, and a retrospective study written in Chinese supporting the use of lung POCUS (Feng et al. 2020).

Evidence for lung ultrasound in other conditions

A randomised controlled trial by Pontet at al (2019) studied the impact of POCUS on resource utilisation, diagnostic accuracy, and clinical management in intensive care units (ICUs) in Uruguay. One group received POCUS and another did not. They found that the POCUS group used fewer resources (chest radiography, additional US evaluations, CT scans). Systematic ultrasound evaluation led to better characterisation of ICU admission diagnosis in 35% of patients and change in clinical management in 60%. The POCUS group had more optimal fluid balance at 48 and 96 hours after admission ($P = 0.01$) and spent less time mechanically ventilated.

Evidence for remote lung ultrasound

A case series of three physician-patients with confirmed stable COVID-19 used lung POCUS for tracking pulmonary disease while in home isolation. They found that lung ultrasound findings corresponded with symptom onset and resolution in all three patients with confirmed COVID-19 during the 14-day isolation period (Shokoohi et al. 2020).

The Canadian Agency for Drugs and Technologies in Health (2020) (CADTH) published a review for a horizon scanning bulletin of the evidence for smartphone-connected ultrasound devices. They concluded that their portability and typically lower price compared to other POCUS systems may allow smartphone- or tablet-connected ultrasound to be used by more clinicians and in more settings, including remote, austere, or military environments. A Rapid Response Report by CADTH (2011), stated that they identified limited evidence regarding the effectiveness of conducting X-ray and ultrasound exams using telehealth technologies for patients in remote communities, but that the evidence they did find suggested that telehealth technologies may be a feasible option for ultrasound exams.

McBeth et al (2011) assessed how practically information from handheld lung POCUS devices could be streamed to a free internet service using a mobile phone. Remote expert sonographers directed remote providers (with variable to no ultrasound experience) to obtain lung images of healthy volunteers. In all lung fields on all occasions, lung sliding could easily and quickly be seen. A later study by McBeth et al (2013) sought to remotely guide ultrasound-naive examiners (five tactical emergency medicine technicians, 10 ski-patrollers, and four

nurses) using a portable lung POCUS system mentored by an expert using either a mobile phone or laptop computer. All ultrasound-naive examiners were successfully mentored to easily and clearly identify both lung sliding and intraperitoneal fluid, leading the author to conclude that ultrasound-naive can confidently be guided to obtain critical findings using simple information technology resources.

Cost

A single-centre, observational, retrospective cohort study of 4,134 medical records of adult patients with pleural-pulmonary conditions in an Italian intensive care unit (population divided into Group A: before introduction of routine use of lung POCUS, and Group B: after introduction of routine lung POCUS) found that the estimated reduction of costs between Groups A and B was 57%. Costs were linked to chest X-ray prescriptions between the two groups (Brogi et al. 2017).

In a letter by Cheung and Lam (2020), the author noted that many hand-held models are affordable even for low-resource regions and some can cost only one twentieth of an ordinary mid-range or high-end ultrasound machines.

The Canadian Agency for Drugs and Technologies in Health (2020) published a review for a horizon scanning bulletin of the evidence for smartphone-connected ultrasound devices. They conclude that these devices typically have a lower price compared to other POCUS systems. They noted that the costs of ownership must also be taken into account for the maintenance and operation of the system. These costs may include: replacement probes, staff training and salaries, maintenance and repair, and hardware and software updates.

Ongoing studies

There are numerous ongoing primary studies investigating the use of lung ultrasound in COVID-19, some of which are for POCUS. The primary studies we identified, along with their anticipated publication dates, are listed in the Brief Literature Results Section. We also identified one Cochrane Review Protocol. The primary objective is to determine the diagnostic accuracy of chest imaging (CT, chest X-ray and ultrasound [including POCUS]) in the evaluation of people suspected to have COVID-19. The anticipated publication date of this review is unknown (McInnes et al. 2020).

Areas of uncertainty

We identified limited evidence for the use of lung POCUS in the diagnosis/management of COVID-19. The evidence we did identify was low-quality and consisted mainly of letters. The majority of the evidence we identified related to the diagnostic accuracy of lung ultrasound (not just POCUS) for pneumonia. We found little evidence for the use of lung POCUS in the management, as opposed to diagnosis, of pneumonia. The reference method used in the majority of the meta-analyses we identified was chest X-ray, and not the gold standard of CT scans, which might confound the findings. High-quality studies using CT scans as the comparator would therefore be desirable. It was not always clear whether the studies investigated lung POCUS or non-POCUS.

Almost all of the evidence identified assessed lung POCUS in the hospital setting. There is limited evidence on its use in other settings, particularly those relevant to the management of COVID-19 such as people isolating at home or people in care homes.

Conclusions

POCUS is currently being used internationally in the management of patients with COVID-19 and has been widely reported. Lung ultrasound is easy to learn, quick to deliver, has lack of ionising radiation, has good portability and repeatability, have fewer infection-control implications than comparators, and impacts on the patient pathway from the triage through to intubation and beyond (UK Intensive Care Society. 2020).

Low-quality evidence investigating its use in COVID-19, and high-quality evidence investigating its use in pneumonia suggests that lung POCUS could be useful in supporting the diagnosis of COVID-19 patients. We identified limited evidence for the use of lung POCUS to monitor patients with confirmed disease, but the evidence we identified suggested that it could be beneficial. Further research on the use of lung POCUS in the diagnosis and management of people with COVID-19 is needed.

We did not identify many studies looking at lung POCUS outside of the hospital setting. The studies that we did identify concluded that remotely tele-mentored lung ultrasound seems suitable for screening for lung involvement of patients with suspected or ascertained COVID-19 infection due to its easy applicability, and that it can be used as a screening method for lung involvement in any care setting, even at the patient's home.

The use of lung POCUS could lead to reduced medical costs, as ultrasound scanners are relatively low-cost regarding maintenance and high durability compared to other imaging modalities. Lung POCUS is also associated with lower financial costs by reducing the use of more invasive and expensive diagnostic tests, shortened stay in the emergency department, and less complications associated with invasive procedures (e.g. thoracentesis).

It is apparent that there are limited people with the appropriate skills to be able to use lung POCUS in the COVID-19 care pathway. The topic proposer has developed a pragmatic approach for upskilling the workforce (Smith et al. 2020).

Brief literature search results

Resource	Results
HTA organisations	
Healthcare Improvement Scotland	We did not identify any relevant evidence from this source
Health Technology Assessment Group	We did not identify any relevant evidence from this source
Health Information and Quality Authority	We did not identify any relevant evidence from this source
UK guidelines and guidance	
SIGN	We did not identify any relevant guidelines/guidance from this source
NICE	NICE guideline (NG173): COVID-19 rapid guideline: antibiotics for pneumonia in adults in hospital. May 2020: https://www.nice.org.uk/guidance/ng173
UK Intensive Care Society	Guidance for lung ultrasound during COVID-19. 2020: https://www.ics.ac.uk/ICS/ICS/FUSIC/FUSIC_COVID-19.aspx
The British Medical Ultrasound Society	COVID-19 lung ultrasound guidance. 2020: https://www.bmus.org/policies-statements-guidelines/professional-guidance/covid-19-lung-ultrasound-guidance/
International guidelines, guidance and evidence	
CADTH	Smartphone-connected ultrasound devices. April 2020: https://www.cadth.ca/dv/ieht/smartphone-connected-ultrasound-devices Rapid response. X-Ray and Ultrasound Imaging via Telehealth: Clinical Effectiveness, Cost-Effectiveness and Guidelines. 2011: https://www.cadth.ca/x-ray-and-ultrasound-imaging-telehealth-clinical-effectiveness-cost-effectiveness-and-guidelines
Secondary literature and economic evaluations	
ECRI	Ultrasound in the age of COVID-19 – guidance through the recovery and future planning. An ECRI lab webcast. May 2020: https://www.ecri.org/landing-covid-19-webcast-ultrasound/ Recommendations for reprocessing ultrasound devices used on COVID-19 patients (ECRI exclusive hazard report): https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-Alert-Reprocessing-Ultrasound-Devices.pdf

EUnetHTA	We did not identify any relevant evidence from this source
Cochrane library	We did not identify any relevant evidence from this source
Medline (Ovid)	Balk DS, Lee C, Schafer J, Welwarth J, Hardin J, Novack V, Yarza S, Hoffmann B. 2018. Lung ultrasound compared to chest X-ray for diagnosis of pediatric pneumonia: A meta-analysis. Pediatric Pulmonology. 53(8):1130-1139. DOI: 10.1002/ppul.24020 Chavez MA; Shams N; Ellington LE; Naithani N; Gilman RH; Steinhoff MC; Santosham M; Black RE; Price C; Gross M; Checkley W. 2014. Lung ultrasound for the diagnosis of pneumonia in adults: a systematic review and meta-analysis. Respiratory Research. 15:50: DOI: 10.1186/1465-9921-15-50 Heuvelings CC, Belard S, Familusi MA, Spijker R, Grobusch MP, Zar HJ. 2019. Chest ultrasound for the diagnosis of paediatric pulmonary diseases: a systematic review and meta-analysis of diagnostic test accuracy. British Medical Bulletin. 129(1):35-5. DOI: 10.1093/bmb/ldy041 Johansen BD, Blue RS, Castleberry TL, Antonsen EL, Vanderploeg JM. Point-of-care ultrasound for pulmonary concerns in remote spaceflight triage environments. Aerosp Med Hum Perform. 2018; 89(2):122–129: https://doi.org/10.3357/AMHP.4808.2018 Llamas-Alvarez AM; Tenza-Lozano EM; Latour-Perez J. 2017. Accuracy of Lung Ultrasonography in the Diagnosis of Pneumonia in Adults: Systematic Review and Meta-Analysis. Chest. 151(2):374-382. DOI: 10.1016/j.chest.2016.10.039 Long L; Zhao HT; Zhang ZY; Wang GY; Zhao HL. 2017. Lung ultrasound for the diagnosis of pneumonia in adults: A meta-analysis. Medicine. 96(3):e5713. DOI: 10.1097/MD.0000000000005713 Orso D, Ban A, Guglielmo N. 2018. Lung ultrasound in diagnosing pneumonia in childhood: a systematic review and meta-analysis. Journal of Ultrasound. 21(3):183-195. DOI: 10.1007/s40477-018-0306-5 Pereda MA; Chavez MA; Hooper-Miele CC; Gilman RH; Steinhoff MC; Ellington LE; Gross M; Price C; Tielsch JM; Checkley W. 2015. Lung ultrasound for the diagnosis of pneumonia in children: a meta-analysis. Pediatrics. 135(4):714-22. DOI: 10.1542/peds.2014-2833 Razak A, Faden M. Neonatal lung ultrasonography to evaluate need for surfactant or medical ventilation: a systematic review and meta-analysis. BMJ Journals. ADC Fetal and Neonatal edition, 105(2): http://dx.doi.org/10.1136/archdischild-2019-316832 Tsou PY, Chen KP, Wang YH, Fishe J, Gillon J, Lee CC, Deanehan JK, Kuo PL, Yu DTY. 2019. Diagnostic Accuracy of Lung Ultrasound Performed by Novice Versus Advanced Sonographers for Pneumonia in Children: A Systematic Review and Meta-analysis. Academic Emergency Medicine. 26(9):1074-1088: https://doi.org/10.1111/acem.13818

	Staub LJ; Biscaro RRM; Maurici R. 2018. Accuracy and Applications of Lung Ultrasound to Diagnose Ventilator-Associated Pneumonia: A Systematic Review. Journal of Intensive Care Medicine. 33(8):447-455. DOI: 10.1177/0885066617737756 Staub LJ, Mazzali Biscaro RR, Kaszubowski E, Maurici R. 2019. Lung Ultrasound for the Emergency Diagnosis of Pneumonia, Acute Heart Failure, and Exacerbations of Chronic Obstructive Pulmonary Disease/Asthma in Adults: A Systematic Review and Meta-analysis. Journal of Emergency Medicine. 56(1):53-69. DOI: 10.1016/j.jemermed.2018.09.009 Xin H; Li J; Hu HY. 2018. Is Lung Ultrasound Useful for Diagnosing Pneumonia in Children?: A Meta-Analysis and Systematic Review. Ultrasound Quarterly. 34(1):3-10: DOI: 10.1097/RUQ.0000000000000330 Ye X, Xiao H, Chen B, Zhang S. 2015. Accuracy of Lung Ultrasonography versus Chest Radiography for the Diagnosis of Adult Community-Acquired Pneumonia: Review of the Literature and Meta-Analysis. PloS one. 10(6), p.e0130066: DOI: 10.1371/journal.pone.0130066
Primary studies	
Medline	Brogi E, Bignami E, Sidoti A, Shawar M, Gargani L, Vetrugno L, Volpicelli G, Forfori F. 2017. Could the use of bedside lung ultrasound reduce the number of chest x-rays in the intensive care unit? Cardiovascular ultrasound. 15(23): https://link.springer.com/article/10.1186/s12947-017-0113-8 Cheung JCH, Lam KN. 2020. Letter. POCUS in COVID-19: pearls and pitfalls. The Lancet. 8(5): DOI:https://doi.org/10.1016/S2213-2600(20)30166-1 Feng XY, Tao XW, Zeng LK, Wang WQ, Li G. May 2020. Zhonghua Erke Zazhi. 58(5):347-350: https://pubmed.ncbi.nlm.nih.gov/32392948/ Mathews BK, Koenig S, Kurian L, Galen B, Mints G, Liu G, Soni NJ. 2020. Clinical Progress Note: Point-of-Care Ultrasound Applications in COVID-19 Journal of Hospital Medicine. 15(6):353-355. DOI 10.12788/jhm.3454 McBeth PB,Crawford I, Blaivas M, Hamilton T, Musselwhite K, Panebianco N, Melniker L, Ball CG, Gargani L, Gherdovich C, Kirkpatrick AW. 2011. Simple, almost anywhere, with almost anyone: remote low-cost telementored resuscitative lung ultrasound. Journal of Trauma, 71: 1528-1535: doi: 10.1097/TA.0b013e318232cca7 McBeth P, Crawford I, Tiruta C, Xiao Z, Zhu GQ, Shuster M, Sewell L, Panebianco N, Lautner D, Nicolaou S, Ball CG, Blaivas M, Dente CJ, Wyrzykowski AD, Kirkpatrick AW. 2013. Help is in your pocket: the potential accuracy of smartphone- and laptop-based remotely guided resuscitative telesonography. Telemedicine and e-health, 19:924–30: https://doi.org/10.1089/tmj.2013.0034

	Pontet J, Yic C, Díaz-Gómez JL, Rodriguez P, Sviridenko I, Méndez D, Noveri S, Soca A, Cancela M. 2019. Impact of an ultrasound-driven diagnostic protocol at early intensive-care stay: a randomized-controlled trial. Journal of Ultrasound (1):24. doi: 10.1186/s13089-019-0139-2 Scheier E. Letter to the Editor. Lung ultrasound cannot be used to screen for COVID-19 in children. European Review for Medical and Pharmacological Sciences, 24: 4623-4624: https://www.europeanreview.org/wp/wp-content/uploads/4623-4624.pdf Shokoohi H, Duggan NM, Sanchez GGdC, Torres-Arrese M, Tung-Chen Y. May 2020. Lung ultrasound monitoring in patients with COVID-19 on home isolation. The American Journal of Emergency Medicine: DOI: https://doi.org/10.1016/j.ajem.2020.05.079
Ongoing primary or secondary research	
PROSPERO database	Yujiao Yang, Yuan Geng, Youbo Zuo, Yong Wan, Biqian Dong. Lung ultrasound for the diagnosis of COVID-19: a systematic review and meta-analysis of diagnostic test accuracy. PROSPERO 2020 CRD42020177803 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020177803 Anticipated completion date: 30 June 2020 Jiang Feng Wu, Yun Lai Wang. Lung ultrasound for the diagnosis of neonatal respiratory distress syndrome: a meta-analysis. PROSPERO 2020 CRD42020149412 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020149412 Anticipated completion date: 31 December 2019 YANG Yujiao, ZHANG Donghang, ZHOU Cheng, HUANG Han, WANG Rurong. Lung ultrasound for the diagnosis of pulmonary atelectasis or consolidation in both adults and pediatrics: a systematic review and meta-analysis of diagnostic test accuracy. PROSPERO 2020 CRD42020162676 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020162676 Anticipated completion date: 13 March 2020 Yujiao Yang, Donghang Zhang, Cheng Zhou, Han Huang, Rurong Wang. Lung ultrasound for the diagnosis of Bronchiolitis in infants: a systematic review and meta-analysis of diagnostic test accuracy. PROSPERO 2020 CRD42020171811 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020171811 Anticipated completion date: 31 May 2020 Ziyue Yang, Shuguang Zhang. Prediction of weaning outcome in mechanically ventilated patients by bedside ultrasound: An updated systematic review and meta-analysis. PROSPERO 2020 CRD42020172687 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020172687 Anticipated completion date: 07 November 2020

Cochrane library	McInnes MDF, Leeflang MMG, Salameh J-P, McGrath TA, Pol CB, Frank R, Prager R, Hare SS, Dennie C, Spijker R . Imaging tests for the diagnosis of COVID-19. Cochrane Database of Systematic Reviews: https://doi.org//10.1002/14651858.CD013639
Clinicaltrials.gov	We identified the following primary studies in progress:

Study title	NCT number	Anticipated study completion
CORonavirus (COVID-19) Diagnostic Lung UltraSound Study	NCT04351802	January 20, 2021
Screening COVID-19 by Point-of-care Lung Ultrasound: a Validation Study	NCT04338568	April 30, 2020
Accuracy of Lung Ultrasound in the Diagnosis of covid19 Pneumonia	NCT04370275	May 31, 2020
Lung Ultrasound to Diagnose COVID-19	NCT04368338	September 28, 2020
The Use of Focused Lung Ultrasound in Patients Suspected of COVID-19	NCT04327674	May 15, 2020
Predicting Outcomes for Covid-19 Using Sonography	NCT04384055	December 31, 2020
Simple, Safe, Same: Lung Ultrasound for COVID-19	NCT04322487	January 15, 2021
One-Year Quality of Life and Functional Prognosis of COVID-19 Patients in Post-ICU Setting	NCT04373811	September 16, 2021
Prognostic Value of Point of Care Cardiac and Lung Ultrasound in COVID-19	NCT04379544	December 2020
The Utility of Bedside Lung Ultrasonography on Diagnosis of COVID-19	NCT04399681	September 10, 2020
Lung Ultrasound for Assessment of Patients With Moderate to Severe Covid-19	NCT04412551	December 31, 2020

	Lung Ultrasound Score in Covid 19 Infectious Disease in Critical Care (LUS-COVID19)	NCT04393402	December 31, 2020
	The Role of Ultrasound in COVID-19	NCT04377035	March 1, 2021
	International Lung UltraSound Analysis (ILUSA) Study	NCT04353141	December 31, 2020
	The Use of Ultrasound in Establishing COVID-19 Infection as Part of a Trauma Evaluation	NCT04340479	May 2022
	WeanINg From Mechanical Ventilation for ARDS CovId-19 Patients Guided by Combined Thoracic UltraSound	NCT04372680	September 22, 2020
	Interest of the Use of Pulmonary Ultrasound in the Referral of Patients With or Suspected COVID-19 +	NCT04335019	May 2020
	Evolution of Pulmonary Ultrasound in Patients Hospitalized for Covid (Coronavirus Disease) 19	NCT04341766	September 30, 2020
	Assessment of Exam Findings in Coronavirus Disease 2019 (COVID-19) With Point-of-Care Ultrasonography (POCUS)	NCT04339998	October 2020
	Risk of Venous Thromboembolism in Critically Ill Patients With Severe COVID-19	NCT04374617	May 1, 2020
	Point Of Care UltraSonography for Risk-stratification of COVID-19 Patients	NCT04338100	January 29, 2021
	Prevalence and Severity of Venous Thromboembolism in a General Population During the COVID-19 Pandemic	NCT04400877	June 30, 2020
	Cardiopulmonary Inflammation and Multi-System Imaging During the Clinical Course of COVID-19 Infection in Asymptomatic and Symptomatic Persons	NCT04401449	May 1, 2024
Other			

Evidence provided by the topic proposer	Smith MJ, Hayward SA, Innes SM, Miller ASC. April 2020. Point-of-care lung ultrasound in patients with COVID - 19 – a narrative review. Anaesthesia 2020: https://doi.org/10.1111/anae.15082

Date of search:	June 2020
Concepts used:	Lung, pulmonary, thoracic, ultrasound, POCUS, sonography, COVID-19, pneumonia