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Training & Accreditation in Physician Performed Ultrasound
Pleural / Lung module

Purpose of Document

This document describes the process for credentialing Intensive Care Unit (ICU) Physicians within Monash Health (MH) to perform Point of Care ultrasound

- Pleural / Lung sonography for pleural effusion, consolidation, pneumonia, B-lines, pulmonary oedema and pneumothorax assessment

Background

The College of Intensive Care Medicine of Australia and New Zealand has incorporated ultrasound skills into the training syllabus of Intensivists and is accrediting teaching hospitals (CICM 2020). Physician performed Point of Care ultrasound (PoCUS) has become an accepted part of clinical management. The immediacy and availability of bedside ultrasound in a variety of clinical contexts means that patient care can be expedited.

Physician performed Pleural/Lung ultrasound enables expedited management of patients with suspected pleural effusion and facilitates sonographic guidance of pleural drainages for ICU patients. Thoracic ultrasound has been shown to be superior to both chest radiography and clinical examination in the detection of pleural fluid (Eibenberger 1994, Diacon 2003). With correct training, physician performed ultrasound has been shown to be safe and effective in the diagnosis and intervention of pleural effusion (Rahman 2011). Ultrasound-guided pleural aspiration and drain insertion have high success and low adverse event rates (O'Moore 1987).

Ultrasound is also useful for the diagnosis of pneumothorax (Lichtenstein 2008), B-lines in acute pulmonary oedema (Volpicelli 2012) and consolidations in pneumonias (Xia 2016). Characterisation of viral pneumonias (including Covid 19) from features of irregular pleural line, B-lines and subpleural consolidations are promising and are being integrated into learning as new evidence emerges. (Volpicelli 2020, Peng 2020)

The Monash Health PoCUS program commenced in 2011, to support the education, training and credentialing of clinicians. The current ICU PoCUS program involves Monash Intensive Care, Monash Imaging and MonashHeart collaborating to ensure excellence in clinician performed ultrasound. A Cardiothoracic integrated approach to Lung and Echo is used in the program.

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Agreed Scope of Practise

This document describes ultrasound training in Pleural/Lung module for pleural effusion, B-lines, consolidation, pneumonia, pneumothorax, and supports learning in guidance for pleural drainage. Ongoing credentialing is provided in the performance of diagnostic ultrasound only. Responsibility for all interventional procedures remains with the ICU.

No clinical management decisions or interventional procedures should be based on PoCUS findings without engagement of PoCUS accredited ICU Consultant and/or formal imaging confirmation (refer also to MH Procedure ICU Dept PoCUS policy document for further information).

All ultrasound examinations are to be documented with archived images/clips as per scan protocols. All PoCUS examinations are to be archived to PACS, enabling scans to be reviewed for clinical, training and quality audit purposes. Scan findings are to be completed for every examination in EMR.

Objectives

At the end of this Pleural/Lung module, the physician will be able to:

- Identify the sonographic anatomy of the chest, including lung, diaphragm and heart

- Optimise the ultrasound image to provide visualisation of the chest and lung

- Use different sonographic windows to insonate the chest to perform scans supine, prone, erect or semi erect according to patient status

- Understand appearances of various lung artefacts and sonographic features of pleural and lung pathologies

- Diagnose pleural effusions, empyema, consolidation (pneumonias), acute pulmonary oedema and pneumothorax

- Perform estimated volume measurements of pleural effusions utilising different calculation methodologies and perform accurate fluid depth/ skin depth measurements

- Utilise ultrasound guidance for pleural aspiration and drainage procedures

- Perform M-mode assessment for pneumothorax

- Perform an ultrasound examination per MH Pleural/ Lung protocols

This document describes:

- A 3 stage process for accrediting ICU Physicians to perform Pleural / Lung ultrasound
    1. Initial Training
    2. Skills Development / Electronic Logbook / MH Accreditation
    3. Ongoing Quality Audit / Skills Maintenance

- A method for auditing scan quality, maintaining a MH electronic logbook and ongoing accreditation
- A practical competency assessment of the skills necessary to obtain and interpret appropriate ultrasound images for a Pleural / Lung examination

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STAGE 1 - Initial Training

Intensive Care Registrars & Consultants intending to perform ultrasound within MH are expected to complete:

- Compulsory online ultrasound physics module
- Prescribed pre-reading
- MH internal PoCUS program course (alternatively recent CICM endorsed external courses may be approved by PoCUS Governance group)

STAGE 2- Program Induction/ Skill Development / eLogbook / MH Accreditation

The integrated Cardiothoracic approach to PoCUS training is a staged approach to FoCUS Echo cardiac & Pleural/Lung modules. Clinicians will complete the practical skills development following the full day course as part of the program training structure. As much bedside one-on-one training is available as needed for clinicians. Practical scanning skills training, mentoring and feedback is offered throughout the completion of Stage 2. Additional self-directed learning is expected including case revision, journal reading and other online resources.

Stage 2 requires the completion of a logbook which documents a minimum of 25 LUNG examinations:

- A minimum of 5 cases in logbook must be positive for a range of pathology including pleural effusion, consolidation (pneumonias), B-lines (acute pulmonary oedema), pneumothorax
- An entry is only valid if the physician is the person performing the examination
- Multiple entries of same patient in the same episode of care by a physician is not acceptable
- Multiple examination types performed on the one patient is acceptable
- Physician is to record an adequate series of images as described in examination protocols
- Physician must complete record of PoCUS scan findings in EMR for all examinations
- PoCUS EMR records are required to facilitate adequate patient identification, upload of scan images to PACS, generation of an electronic logbook and quality auditing process based on documented clinician scan findings
- Logbooks are maintained for clinicians by Monash PoCUS program indefinitely & circulated to clinicians periodically as part of quality audit feedback (not just in credentialing phase)
- All examination images will be transmitted to Monash Imaging (general scans) or Monash Heart (echo scans) PACS
- Physician will be provided with support & feedback whilst employed by Monash Health

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Quality Auditing

Regular auditing will be conducted and data maintained by PoCUS program sonographer educators. Quality audit reports will be provided to ICU PoCUS Governance Group, including Directors of Ultrasound & Intensive Care. Examinations will be qualitatively assessed using a simple system assessing technical adequacy and diagnostic accuracy of examination, with reference to correlative imaging, surgical or clinical findings where available.

eLOGBOOK QUALITY AUDIT FEEDBACK	
3	**good scan, accurate diagnosis & technical quality**
2	**technical errors, but no misdiagnosis**
1	**false negative**
0	**false positive**

Audit results and comments for clinician feedback will be provided in personal elogbooks maintained for clinicians (see also Audit Guidelines). A minimum 25 Pleural/Lung examinations will be audited until a physician achieves MH credentialing. Thereafter, random audit of a minimum 5 examinations will be conducted yearly to ensure maintenance of skill and quality.

Accreditation

Once logbook requirements (minimum scan numbers and positive cases) are completed, a practical competency assessment will be conducted by program Sonographer & final approval made by ICU PoCUS Governance group.

Alternative Accreditation Pathways

In certain select situations, alternative accreditation pathways may be considered for approval by ICU PoCUS Governance group.

> A. *Fast tracked 'grandfathering' credentialing for clinicians with considerable prior experience, but no formal credentialing.*
> B. *Recognition of ASUM CCPU, DDU, Melb Uni Cert Echo or other credentials from external institutions. This process would involve Monash Health PoCUS program induction & practical competency assessment by Sonographer educators & approval by ICU PoCUS Governance group.*

STAGE 3: Ongoing Skills Maintenance

After completing the MH Accreditation process, the ICU Physician is able to perform Pleural/Lung scans within MH. In order to maintain MH credentials they are required to:

1. Perform and log a minimum of 10 scans annually (no required number of positives)
2. Undertake 3 hours of ultrasound education annually, including a one hour refresher session to receive ongoing tuition through review of their own logged cases, audit results and practical scanning with Sonographer educators or officers of ICU Governance Group

LUNG ULTRASOUND Training

System Set-up

- Turns machine on, enter patient UR, surname & Dr initials
- Selects correct transducer
- Selects correct exam presets

Image optimization

- Gain / TGC
- Depth
- Focal zone
- Frequency

Recognition of artefacts

- Increased attenuation of ultrasound beam due to patient habitus
- Artefacts from air or fluid filled lung and diagnostic features associated with various pathology
- Shadowing from ribs

Image interpretation

- Identification of potential spaces for fluid (pleural space, peritoneum, pericardium)
- Recognition of the presence of fluid in peritoneum, pericardium or pleural space
- Differentiation between simple pleural fluid and complex fluid or blood
- Identification of lung collapse and consolidations, including air bronchograms
- Identification of lung B-lines associated with pulmonary oedema or pneumonias
- Identification of sonographic features of pneumothorax
- Ability to perform M-mode trace to exclude pneumothorax
- Understanding of diagnostic limitations and potential mimicks

Scan technique

- Pleural / Lung scanning will vary according to patient position, presentation & suspected pathology to be confirmed or excluded
- A lung zone approach is advocated with six zones defined for each side: Zone 1-2 anteriorly, Zone 3-4 laterally, Zone 5- 6 posteriorly
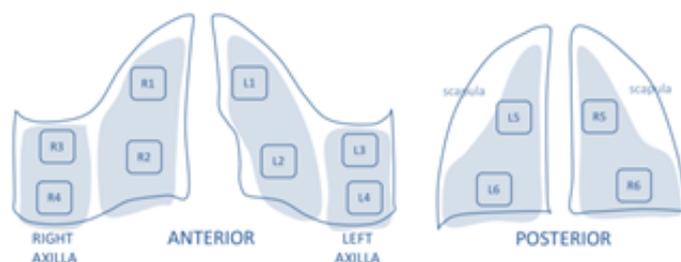
Zone 4 & Zone 6 (PLAPS point): assessment of pleural effusion, collapse & consolidations

- o Use curvilinear or sector probe on pleural, chest, abdo or cardiac setting for penetration at bases
- o May be performed with patient supine, prone, semi erect or erect
- o Longitudinal/ coronal views mid axillary line to posterior lung base regions
- o Demonstrate the diaphragm, liver/spleen, pleural space, lung curtain
- o Identify presence/absence pleural fluid (gravity dependent)
- o Identify presence/ absence lung collapse or consolidation
- o Label images with side & zone eg. RIGHT Z4 or R4

Zone 1 to Zone 6: assessment of B lines, pleural line & consolidations

- o Use curvilinear or linear transducer on lung setting
- o May be performed with patient supine, prone, semi erect or erect
- o Longitudinal, oblique and transverse views to assess multiple lung zones
- o Demonstrate rpleural line & lung to approx 10cm depth
- o Identify normal / irregular pleural line
- o Identify presence/ absence >3 B lines in rib interspace in 2 or more lung zones in pulmonary oedema
- o Identify presence/ absence abnormal B lines (focal or patchy distribution) in pneumonias
- o Identify presence/ absence larger focal or lobar consolidation +/- air bronchograms in pneumonia
- o Identify presence / absence multiple small subpleural consolidations in viral pneumonia
- o Label images with side & zone eg. RIGHT Z5 or R5
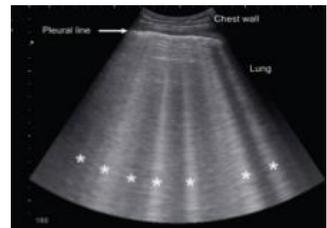
Zone 1 & Zone 2: assessment of pneumothorax

- o MUST be performed with patient supine
- o Longitudinal view at most anterior region of chest in mid-clavicular line
- o Demonstrate lung, pleural line, rib shadows, lung sliding
- o Identify presence/absence of pneumothorax (lung slide, B lines)
- o Acquire M-mode trace to verify the presence/ absence of pneumothorax (sea/sand)
- o Label images with side & zone eg. LEFT Z2 or L2
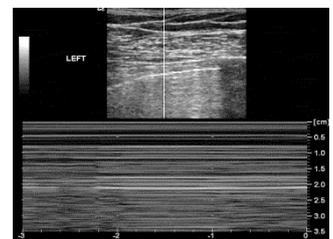
Examination documentation

- Document scan findings via EMR adhoc charting PoCUS worksheet

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RIGHT/ LEFT CHEST

Pleural effusion	◯ No	◯ Yes	◯ Small-Medium ◯ Large ◯ Simple ◯ Complex

B line abnormality ◯ No ◯ Yes ◯ Diffuse ◯ Confluent

Lung Zones ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6

Lung consolidation ◯ No ◯ Yes ◯ Focal ◯ Lobar/segmental ◯ Air bronchograms

Lung Zones ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6

Pleural line irregularity ◯ No ◯ Yes

Lung Zones ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6

Pneumothorax ◯ No ◯ Yes ◯ Non-diagnostic

Further comments:

Integration of results to management of the patient
- Correlate scan findings and features with clinical presentation for likely diagnosis
- Recognise the limitations of a scan technically and diagnostically
- Identify patients requiring formal imaging assessment
- Refer to Monash ICU Dept PoCUS policy document regarding clinical decision making based on PoCUS findings

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Practical Evaluation for Accreditation ICU LUNG

Name:

Hospital:

Date:

PoCUS assessor:

	0	**1**	**2**
Explains examination to patient or carers & obtains consent	Incomplete or misinformation	Explanation complete but brief	Full explanation with indication and limitations
Entry of patient details, selection of transducers & presets	Unable to complete task completely	Task completed but with hesitancy	Utilises equipment & presets confidently & appropriately
Image optimisation (depth, gain, TGC, focus)	Suboptimal image quality	Optimizes image but uncertainty using controls	Optimizes image confidently & appropriately
Assessment of right and left pleural spaces Z4-6 PLAPS point	Unable to correctly demonstrate anatomy	Anatomy partially demonstrated	Systematic approach in demonstrating all anatomy
Demonstration of right and left lung zones 1- 6 pleural line, B lines	Unable to correctly demonstrate anatomy	Anatomy partially demonstrated	Systematic approach in demonstrating all anatomy
Demonstration of right and left lung zones 1- 2 lung sliding, batwing sign	Unable to correctly demonstrate anatomy	Anatomy partially demonstrated	Systematic approach in demonstrating all anatomy
Documentation of examination (images, measurements, M-mode)	Incorrect or inadequate imaging, measurements or M-mode	Minor inaccuracy of imaging, measurement or M-mode	Accurate imaging, measurements and M-mode
Interpretation of ultrasound images & lung artefacts	Unable to interpret ultrasound appearances correctly	Correct but some hesitancy interpreting appearances	Correct and confident interpretation of appearances
Interpretation of pathology & lung artefacts in case based review	Unable to interpret ultrasound appearances correctly	Correct but some hesitancy interpreting appearances	Correct and confident interpretation of appearances & pathology

QUALITY AUDITING

Pleural/Lung examinations will be regularly audited by PoCUS program sonographer educators for technical and diagnostic accuracy. Reference to correlative imaging (CT/MR/CXR/US), surgical or other clinical findings will be made when available. Audit results will be recorded in e-logbooks for clinician quality feedback. A coloured 'traffic light' system of visual quality feedback will be used (see details below) with further audit comments as required.

All cases with significant diagnostic error or quality problems (false positive, false negative) will be reported to Director of Ultrasound/Cardiology and ICU PoCUS Governance group for review. Immediate feedback by email or in person, will be given by program sonographer for such cases. The ICU PoCUS governance group will follow up issues of repeated poor quality or program non-compliance.

	ELOGBOOK QUALITY AUDIT FEEDBACK SYSTEM
3	good scan, accurate diagnosis & technical quality
2	minor technical errors, see comments, no misdiagnosis
1	false negative
0	false positive

GREEN flag will be recorded for an examination with correct scan planes, adequate sonographic anatomy visualised for each view and correct clinician interpretation, as detailed in scan audit criteria below.

ORANGE flag (with audit comments) will be recorded for any incorrect scan planes, suboptimal demonstration of anatomy or suboptimal technical settings, as detailed in scan audit criteria below.

RED flag (with audit comments) will be recorded for any false positive or false negative scan findings, whether from technical or interpretive errors, as verified by correlative imaging or other clinical findings. Review of significant false positive/ false negative cases will be made by PoCUS committee & Director of Ultrasound/Cardiology as required.

QUALITY AUDITING GUIDELINES

Zone 4 & Zone 6 (PLAPS point): assessment of pleural effusion, collapse & consolidations

- ✓ *Longitudinal/ coronal plane views of right or left pleural space*
- ✓ *Curvilinear or phased array transducer on Chest/Cardiac preset for penetration*
- ✓ *Anatomy includes diaphragm, liver/spleen, anterior chest wall, lung without excessive rib shadowing*
- ✓ *Depth adequate if no portion of the posterior/deep pleural space and diaphragm is cut off*
- ✓ *Gain/TGC adequate to demonstrate anterior chest wall & pleural line, with gain adequate to demonstrate pleural effusion, without over-gain or under-gain obscuring pleural effusion, septations or lung consolidation detail*
- ✓ *Focal Zone adequate if focal zone is +/- 5cm mid image field*
- ✓ *Labelled correctly side & lung zone*

Zone 1 to Zone 6: assessment of B lines, pleural line & consolidations

- ✓ *Curvilinear or linear transducer on lung preset*
- ✓ *Multiple lung zones assessed, multiple scan planes as needed*
- ✓ *Anatomy includes anterior chest wall, lung, pleural line and ribs*
- ✓ *Depth adequate if no portion of the pleural line is cut-off and approx 10cm of lung field/ B lines are displayed*
- ✓ *Gain adequate to demonstrate pleural line, consolidation, air bronchogram and B-lines without over-gain OR under-gain obscuring diagnostic detail*
- ✓ *Focal Zone adequate if focal zone is +/- 5cm mid image field*
- ✓ *Labelled correctly side & lung zone*
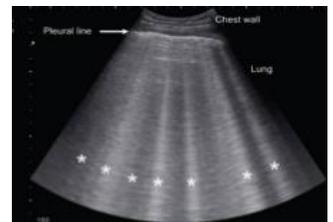
Zone 1 & Zone 2: assessment of pneumothorax

- ✓ *Linear or curvilinear transducer on lung preset*
- ✓ *Longitudinal views at anterior region of chest Z1-2*
- ✓ *Anatomy includes anterior chest wall, lung, pleural line and ribs*
- ✓ *Depth adequate if no portion of the pleural line is cut-off and not more than 10cm of lung field displayed*
- ✓ *Gain adequate to demonstrate pleural line and M-mode trace without over-gain OR under-gain obscuring diagnostic detail*
- ✓ *Focal Zone adequate if focal zone is +/- 3cm level of pleural line*
- ✓ *Labelled correctly side & lung zone*

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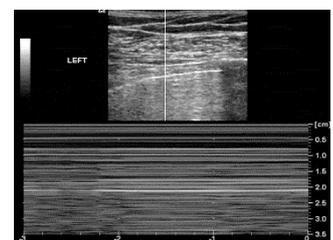
References:

Volpicelli G, Elbarbary M, Blaivas M, et al. International evidence-based recommendations for point-of-care lung ultrasound Intensive Care Med 2012; 38:577-591

Volpicelli G & Gargani L. Sonographic signs and patterns of COVID-19 pneumonia. Ultrasound J (2020) 12:22 https://doi.org/10.1186/s13089-020-00171-w

Husain L, Hagopian L, Wayman D, et al. Sonographic diagnosis of pneumothorax J Emerg Trauma Shock. 2012 Jan-Mar; 5(1): 76–81.

Lichtenstein D, Meziere G. Relevance of lung ultrasound in the diagnosis of acute respiratory failure – the BLUE protocol. Chest 2008; 134:1;117-125

Lichtenstein, D Lung ultrasound in the critically ill. Annals of Intensive Care 2014, 4:1

Balik M, Plasil P, Waldouf P, et al. Ultrasound estimation of volume of pleural fluid in mechanically ventilated patients. Intensive Care Med 2006; 32:318-321

Rahman N, Singanayagam A, Davies H, et al. Diagnostic accuracy, safety and utilisation of respiratory physician-delivered thoracic ultrasound. Thorax 2010; 65:449-453

Eibenberger K, Dock W, Ammann M, et al. Quantification of pleural effusions: sonography versus radiography. Radiology 1994;191:681-4.

Diacon A, Brutsche M, Soler M. Accuracy of pleural puncture sites: a prospective comparison of clinical examination with ultrasound. Chest 2003;123:436-41.

O'Moore P, Mueller P, Simeone J, et al. Sonographic guidance in diagnostic and therapeutic interventions in the pleural space. AJR Am J Roentgenol 1987;149:1-5

Xia Y, Ying Y, Wang S et al. Effectiveness of lung ultrasonography for diagnosis of pneumonia in adults: a systematic review and meta-analysis. J.Thor.Dis. 2016; 8(10): 2822–2831

Peng Q, Wang X, Zhang L. Findings of lung ultrasonography of novel corona virus pneumonia during the 2019–2020 epidemic. *Intensive Care Med* (2020). https://doi.org/10.1007/s00134-020-05996-6

College of Intensive Care Medicine of Australia and New Zealand (CICM) Competencies, Learning Opportunities, Teaching and Assessments for Training in General Intensive Care guidelines 2014

Australian Society of Ultrasound in Medicine (ASUM) Policy B8 Statement on the Use of Ultrasound by Medical Practitioners 2008; Crows Nest, NSW.