

PRE-HOSPITAL ULTRASOUND

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James Sen, Christopher Edmunds, Simon Carley, Charlotte Haldane, Roderick Mackenzie, Marcus Peck, Nick Smallwood, Carl Smith, Sam Sweeney & Chris Yap

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Introduction

Point-of-care ultrasound (POCUS) is well established within many areas of hospital medicine and has been used in pre-hospital care since the early 2000s. (1) POCUS was included in the UK Pre-hospital Emergency Medicine (PHEM) sub-specialty curriculum in 2012 and has been incorporated into the Fellowship in Immediate Medical Care (FIMC) examinations since 2021.(2)

This consensus statement provides evidence-based guidance and expert recommendations on how clinicians and services can develop their use of pre-hospital ultrasound (PHUS) to ensure that it is safe and effective through proper governance and training.

Background

Advances in ultrasound technology, most notably in the portability of modern devices, have meant that pre-hospital ultrasound (PHUS) is more readily available to pre-hospital providers worldwide. Many pre-hospital care providers use PHUS regularly as part of clinical care.(3)(4)(5)(6)

The medical indications for performing POCUS do not differ between pre-hospital and hospital environments. However, there are several factors that make it more challenging. Environmental factors that can impact on the use of PHUS include increased noise levels, limited workspace in an ambulance or helicopter (where often only one side of the patient is accessible), vibration effects during transportation, weather, poor lighting conditions and limited resources. Importantly, any pre-hospital intervention or diagnostic test should not prevent the timely transportation of patients from the scene to definitive care at a hospital and as such the use of PHUS should be considered in this context.(7)(8)

The evidence base to support PHUS delivery is limited but has shown that it is feasible and can lead to changes in patient management.(9)(10) However, diagnostic accuracy studies of pre-hospital ultrasound have shown inferior performance when compared with hospital studies.(11)(12) This highlights the importance of established governance and training processes around the use of PHUS and the need to account for the different staff groups within pre-hospital clinical practice.(13)

Consensus Recommendations

Clinical Application of Pre-hospital Ultrasound

1. Clinicians should only use pre-hospital diagnostic ultrasound to answer a focused question, where the answer will alter the pre-hospital clinical management, and not delay time-critical interventions both pre-hospital and in hospital [Grade D]

For the purposes of this consensus statement, we categorise PHUS use as embracing two overlapping terms:

- *Diagnostic* (to answer a focused clinical question to assist in diagnosis, triage, or decision-making e.g. ruling in/out pneumothorax, pericardial effusion, intra-abdominal bleeding),
- *Procedural* (to support a clinical procedure such as central or peripheral vascular access or administering a nerve block).

Diagnostic PHUS can alter management in a range of critically ill and injured patients. However, there is concern that undertaking diagnostic PHUS can increase on-scene times and therefore delay definitive treatment.(9) Examinations that may not impact **on-scene** management (such as scanning for intra-abdominal free fluid) and are feasible to perform in transit, can reduce time to definitive intervention in the hospital setting.(10)(14) The authors agree that diagnostic PHUS can be performed whilst on route to hospital, although with some limitations regarding space around the patient and movement artefact.

2. Procedural application of ultrasound should only be used where it facilitates or enhances timely intervention and can be performed without unnecessarily delaying essential care or transport [Grade D]

Ultrasound is often used to guide specific technical procedures such as arterial or venous cannulation and regional anaesthetic techniques. It improves efficacy of fascia iliaca nerve blockade, first-pass arterial cannulation, and the success rate and time taken to establishing pre-hospital venous access.(15)(16)(17)

Clinicians must balance the potential benefits of PHUS against increase in scene time and its other related harms.

3. Clinicians must recognise the technical and environmental limitations of PHUS and incorporate these into interpretation and decision-making [Grade C]

When interpreting PHUS, providers must consider potential limitations due to environmental factors (e.g. lighting, noise, vibration, weather and confined space) and equipment constraints (e.g. image resolution of handheld devices).(18)(19) Some protocols (e.g. eFAST, which looks for conditions such as pneumothorax, haemothorax and the presence of intra-abdominal free fluid) have lower sensitivities in a pre-hospital setting. Knowledge of this should inform the degree of diagnostic certainty. (11)(20)(21) Clinicians should be aware of the risk that performing PHUS may temporarily reduce situational awareness or delay other priorities in dynamic environments.(18)

4. Clinicians from diverse backgrounds, including paramedics and other allied healthcare professionals, can undertake PHUS autonomously where governance structures support appropriate training, assessment and ongoing oversight [Grade D]

PHUS is not limited to any single professional group and worldwide it is used by a variety of allied healthcare professionals including paramedics. Within a system that includes training and appropriate governance, allied healthcare professionals can adequately obtain and interpret PHUS images under protocol.(22)(13)(5)

Governance of Pre-hospital Ultrasound

5. Pre-hospital services using ultrasound must have a nominated clinical lead with responsibility for the oversight and governance of PHUS [Grade D]

This reflects the recommendations from the Intensive Care Society (ICS), the Society for Acute Medicine (SAM), the Royal College of Emergency Medicine (RCEM), the British Medical Ultrasound Society (BMUS) and the Royal College of Radiologists (RCR).(23)(24)(25)(26)

6. Clinically relevant images and videos must be securely stored for quality assurance purposes, with appropriate data governance. Any interpretation and decision making should be clearly documented in the clinical record [Grade D]

This reflects the recommendations from ICS, SAM, RCEM, BMUS and RCR.(23)(24)(25)(26) Information governance must follow the legal framework for the country in which the ultrasound is performed in. For example, in the UK GDPR DPA (2018) legislation and national requirements must be adhered to.(27)(28)

7. Pre-hospital organisations must ensure that PHUS use is subject to a defined governance framework that includes quality assurance and quality control processes [Grade D]

Each organisation must maintain a documented governance framework that sets out: the scope of PHUS uses within the service, local training and supervision standards, audit processes and reporting/escalation pathways for identified concerns.

Quality assurance processes (error prevention) should include regular audit of: indications for PHUS, adherence to protocols, appropriateness of use and whether PHUS findings were clearly documented and appropriately integrated into decision-making. This should form part of a regular service review and may be used in clinical appraisal.

Quality control activities (error detection) should include: periodic image review (random or targeted) by trained reviewers, structured feedback to clinicians undertaking PHUS and case review if PHUS has contributed to an adverse or unexpected outcome.

8. Choice of ultrasound equipment should be appropriate to its intended use. It must be serviced regularly and kept up to date in accordance with local and manufacturer policy [Grade D]

Different pre-hospital providers may have different requirements when choosing an ultrasound device. Consideration may be made to size, weight, image quality, software, connectivity, functionality and cost.⁽¹⁹⁾ In the UK, the Medicines and Healthcare products Regulatory Agency (MHRA) is responsible for regulating the UK medical devices market and ultrasound devices must be registered with them before being placed on the UK market.

9. Infection control measures must be adhered to at all times [Grade C]

Ultrasound gel has been associated with outbreaks of infection in various settings worldwide, most recently with *Burkholderia Cepacia*.⁽²⁹⁾ Sterile gel should be used when ultrasound is being used as part of an invasive procedure, when it is near or on non-intact skin, or mucous membranes, when the patient is immunocompromised or critically ill, or when it is likely that an invasive procedure will be performed in the next 24 hours.⁽²⁹⁾ The British Medical Ultrasound Society (BMUS), Association of Healthcare Technology Providers for Imaging, Radiotherapy & Care (AXREM) and the Society & College of Radiographers (SCoR) have produced a best practice summary on decontamination of ultrasound transducers.⁽³⁰⁾

Competency & Training

10. Each organisation must ensure that clinicians performing PHUS are assessed as competent in each examination type by a suitably qualified and experienced PHUS trainer [Grade D]

Assessment should follow completion of an approved PHUS training programme, or evidence of established practice with documented knowledge and experience.

A PHUS trainer should be:

- an **experienced** prehospital clinician (one who regularly practices in the prehospital environment, exercises clinical autonomy, and is recognised by their service or training body as competent in both prehospital care and the specific ultrasound modality being used);
- **accredited** in the relevant ultrasound modality for their specialty or professional background (e.g. FUSIC, FAMUS, PGCert Medical Ultrasound or equivalent, such as 'entrusted to act unsupervised' or RCEM Entrustment Scale 4 in UK medical training frameworks); and
- **trained** in clinical supervision and assessment (i.e. has undertaken recognised training in supervising and assessing clinical learners, including direct observation, feedback, and sign-off processes aligned with professional and organisational governance).

Assessment should be structured, documented and aligned with national or regional standards where available.

11. During training or development towards independent PHUS practice, all scans should be reviewed by a supervisor within a clinically relevant timeframe [Grade D]

Supervision may include a combination of direct (in-person), remote (e.g. live stream) or retrospective (e.g. image review) approaches, depending on context and urgency.⁽²³⁾⁽³¹⁾⁽³²⁾ Organisations should ensure that supervision arrangements align with professional background, training pathway and governance framework.

12. To maintain competency in PHUS clinicians should complete regular CPD and be able to demonstrate regular practice [Grade D]

This reflects those recommendations from ICS, SAM, RCEM, BMUS and RCR.(23)(24)(25)(26)

13. Organisations delivering PHUS must ensure that systems are in place for the governance, supervision, and quality assurance of both training and independent clinical use [Grade D]

This includes maintaining:

- a register of trained clinicians and their scope of practice
- documentation of supervision and sign-off
- a process for reviewing **all** training phase scans and audit of clinical use
- integration of PHUS into annual clinical appraisal and revalidation

14. Organisations must provide access to training opportunities which ensure clinicians develop competencies that match their clinical requirements [Grade C]

PHUS covers a wide range of techniques ranging from basic (e.g. discriminating a beating from non-beating heart) to more complex (e.g. higher-level echocardiography). Training must reflect the time and effort required to achieve and maintain competency in each skill. The clinical and practical context for PHUS differs significantly from that found in formal healthcare environments. Sonographic findings are likely to be evolving and scanning is more likely to be technically challenging.(33)(18)

For that reason, specific training in PHUS should be tailored towards the challenges presented by the environment and a wide range of clinician backgrounds. Reported types of PHUS training include: e-learning modules, lectures, hands-on practise, simulation-based training and more commonly a combination of each.(34)(35)(36)(13) Many bespoke PHUS training programmes have demonstrated improvements in knowledge, image acquisition and interpretation.(37)(38)(39)(40)(41)(34) Where possible, training should be mapped

to recognised curricula (e.g. RCEM Core PoCUS, FUSIC, FAMUS, IBTPHEM) and adapted for pre-hospital delivery.

Conclusion

PHUS represents a transformative tool in pre-hospital emergency medicine with the potential to enhance diagnostic accuracy, guide clinical decision-making and improve patient outcomes. This consensus statement reflects the collective insights of clinicians, educators, and researchers, aiming to establish a pragmatic framework for the safe, effective and evidence-based use of PHUS. While PHUS should not replace clinical judgment or standard care protocols, its application, supported by robust governance, structured training and ongoing evaluation, can elevate the quality of care delivered in this setting. Continued research, education and collaboration across services will be essential to realise the full benefits of pre-hospital ultrasound and safeguard against its misuse or over-reliance.

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Appendix B - Methods

Following approval of the topic by the FPHC Chair of Standards Committee, selection of the consensus statement development group (CSDG) took place. Representatives include paramedic and medical backgrounds, from a range of specialties that include pre-hospital emergency medicine, anaesthesia, emergency medicine, acute medicine and intensive care medicine. Many of the members have significant experience or are currently working in roles related to governance in ultrasound for these specialties.

All members of the CSDG met on 7th January 2025 to formulate objectives for the consensus statement and the key questions that should be answered by the statement. The questions proposed include:

- When should PHUS be performed?
- When should PHUS not be performed?
- Who can undertake PHUS?
- How should PHUS be governed?
- What is the minimum and optimum standard for training of PHUS delivery?
- How should clinicians maintain competency?
- How should prehospital organisations deliver PHUS training?
- What is the minimum standard for equipment for the clinical delivery of PHUS?
- What are the required Infection, Prevention and Control standards for PHUS use?
- What is the required standard of trainers in PHUS?

- How should ultrasound images be stored, communicated and reviewed?

The consensus from the group was that the statement's purpose was not to teach how to perform an ultrasound examination, but instead to guide clinicians by also providing examples of good and poor practice. Its aim was also to guide services in how to govern its use, provide training and support their clinicians.

MEDLINE/PubMed, CINAHL and Embase searches were conducted by JS, with collaboration from an information specialist, on the 5th February 2025. The following search terms were used:

	<i>Population</i>	<i>Index Test</i>
Boolean operators	AND	AND
OR	Pre-hospital	Ultrasound
OR	Helicopter	Sonography
OR	In-flight	POCUS
OR	Emergency medical services	PHUS
OR	ambulance	
OR	Pre-hospital	

217 articles were initially identified after duplicates were removed. Authors JS and CE then independently, and blinded to each other, reviewed the abstracts using Rayyan software. Papers were included if they reported on diagnostic accuracy of

PHUS, training or governance. JS and CE met on 24th March 2025 and went through those where there was disagreement and reviewed the full text article to decide if the article met the broad inclusion criteria. In total 116 articles were selected for inclusion. Citation chaining was performed and a further 16 articles were also reviewed.

The collected evidence and its relevance to the questions formulated and objectives of the consensus statement were presented to the CSDG on 3rd April 2025 alongside a draft consensus statement produced by JS and CE.

The group then engaged in detailed discussions on the three topics of clinical application, governance and training of PHUS. Recommendations were scrutinized to ensure that they were relevant, used appropriate nomenclature and were of importance to clinicians and pre-hospital services.

The aim of the clinical section was to highlight the point that different professionals can perform PHUS in a well governed system, but that the specific limitations of PHUS should be considered.

For the Governance section, the group added further detail to the governance frameworks recommended. With significant expertise in the group on this matter, we ensured that these recommendations aligned with other national bodies and their position on POCUS. All the group felt that there was importance in discussing the infection risk of ultrasound use, and particularly the use of ultrasound gel. In many pre-hospital services, that attend critically ill patients, it is recommended that sterile ultrasound gel should be used.

Defining what constitutes a PHUS trainer was a priority of the group and this is now clearly described. The group steered away from defining a formal training pathway for all but put the onus on pre-hospital organisations to ensure training opportunities are available for clinicians, who may have gaps in their scope of PHUS practice.

The clinical examples were felt to be a highly valuable resource for clinicians accessing the statement, including those that do not use PHUS. The original number of 8 was deemed too many so these were rationalised.

The draft was revised following these discussions and sent back to all of the members of the CSDG for their review and approval.

Appendix C – Clinical Examples of PHUS

These clinical vignettes are intended to illustrate where PHUS can assist or hinder clinical practice in PHEM. They are vignettes and therefore not complete clinical records. Whilst readers may be able to envisage times where the examples below do not apply, we hope that the reader will be able to see the broadly applied and relevant principles.

Examples of GOOD practice	Examples of POOR practice
Example	Example
A pre-hospital team attends a 48-year-old male patient with a sudden onset of abdominal pain and dizziness. Hypotension is noted. The abdomen is soft. An ultrasound of the aorta is undertaken and identifies a 9 cm abdominal aortic aneurysm (AAA). The team is 10 minutes from an emergency department (ED) but 40 minutes from an ED with vascular surgical specialities on site. In accordance to agreed regional pathways the patient is triaged to the site with vascular surgery and successfully undergoes an aneurysm repair without the need for a further transfer.	A pre-hospital clinician is asked to support an ambulance service crew at scene with a 75-year-old who has suffered a cardiac arrest. On arrival the patient has had 40 minutes of CPR with all reversible causes considered and addressed. The patient has been in asystole for 30 minutes, but the crew is worried as the patient had chest pain with them prior to the cardiac arrest. All interventions have been appropriately delivered. They specifically want an ultrasound to support the cessation of resuscitation attempts. The family are extremely distressed. The PHUS shows a cardiac standstill and the resuscitation is stopped.
Rationale	Rationale
PHUS is a useful tool to identify abdominal aortic aneurysm and when performed by non-radiologists has a high sensitivity (0.975, 95% CI: 0.942-0.992) and a high specificity (0.989, 95% CI: 0.979-0.995).(42) Performing it in appropriately selected patients, as in this case where there is a low index of suspicion, will	In the UK the Joint Royal Colleges Ambulance Liaison Committee (JRCALC) has clear guidelines on supporting cessation of resuscitation in this context and a PHUS is not needed to support this course of action.(46) The PHUS has been used to justify a decision,

enable improved care and more nuanced triage, reducing delay to aneurysm repair.(43) In this case the use of PHUS allowed appropriate triage and avoided a secondary transfer to a vascular surgical centre.(44) In cases where there is a high index of suspicion for a ruptured AAA, NICE guidelines exercise caution for the harm caused by a false-negative result.(45) This is due to the tendency of ultrasound to underestimate aneurysm diameters, based on inter-technique data.	prolonging the resuscitation in an unnecessary fashion. This could have been avoided.
Example	Example
A pre-hospital care team attends a motorcyclist involved in a collision. Primary survey found a head injury with reduced GCS and crepitus on palpating the right anterior chest wall. Observations included a blood pressure of 158/84, a heart rate of 62 and oxygen saturations of 99% on air. PHUS was performed and the chest wall was scanned on both sides in superior and inferior anterior and lateral zones. Lung sliding was observed throughout on both sides. 20 minutes following this pre-hospital emergency anaesthesia (PHEA) was performed and 5 minutes later the patient had a heart rate of 114, and blood pressure of 104/68. The pre-hospital care team did not rely upon their earlier scan and repeated the lung ultrasound. This identified on the right side: no lung sliding, no lung pulse and no B-lines.	A 35-year-old male falls from a second-storey scaffold (approx. 6 metres). On arrival, he is alert and breathing spontaneously. His vital signs are: respiratory rate 28, heart rate 108, blood pressure 89/62 mmHg. He has tenderness over the pelvis and left upper quadrant, but no visible external injuries. The pre-hospital clinician performs an eFAST scan, which is negative for pneumothorax, haemothorax, pericardial effusion, and intra-abdominal free fluid. Based on the scan, the clinician decides not to pre-alert or convey the patient to a major trauma centre and instead transports the patient to a local emergency department.

These findings indicated the presence of a pneumothorax and was managed accordingly.	
Rationale	Rationale
PHUS has a low sensitivity for the presence of pneumothorax when compared to ultrasound performed in hospital.(11) Lung ultrasound should not be performed in a single point and should be extended laterally and posteriorly, where possible, as traumatic pneumothoraces can be loculated by contusional adherence.(33) This is especially the case when there is a high index of suspicion for pathology to be found. When the patient deteriorates this prompted the pre-hospital team to repeat the lung ultrasound, which demonstrated features of pneumothorax on lung ultrasound.(47) An initial negative scan for pneumothorax does not exclude its presence.(33)	While there are different trauma triage tools around the UK, this patient clearly triggers the Major trauma triage tool study (MATTS) triage tool based on: Step 1b – Vital signs: SBP <90 mmHg Step 2b – Anatomical suspicion: mechanism and tenderness suggest possible major pelvic injury.(48) Pre-alert and bypass to a Major Trauma Centre were therefore indicated. A negative eFAST scan for the presence of intra-abdominal fluid does not reliably exclude its presence.(21)(14)(20) When there is a high index of suspicion for traumatic intra-abdominal injury, a negative eFAST result should not be used in isolation to guide ongoing management decisions, such as administration of blood products or selection of destination hospital.(49)
Example	Example
A pre-hospital clinician attends an elderly female patient who has fallen from standing and has a suspected neck of femur fracture. Her medical background includes COPD and chronic kidney disease. The pre-hospital clinician performs an ultrasound guided fascia iliaca block.	A pre-hospital team attends a 28-year-old male who has sustained a single central stab wound to the chest. On arrival, the patient is unresponsive, pulseless, and in a narrow complex rhythm on ECG. The estimated time from injury is recent but uncertain. The clinical team delays intervention to perform a PHUS, which shows a large pericardial effusion.

	During the scan, the patient deteriorates into asystole. A resuscitative thoracotomy is then performed but the patient does not survive.
Rationale	Rationale
Early administration of a fascia Iliaca block is recommended in patients with a fractured neck of femur and has been shown in a pre-hospital setting to reduce pain scores more than opioid analgesia and sedative agents alone.(50) The use of ultrasound to guide administration of local anaesthetic, as opposed to landmark techniques, has been shown to increase the efficacy of the block.(17) This procedure has a good safety profile and very few documented adverse events.(50)(51)	In a patient with traumatic cardiac arrest and suspected penetrating cardiac injury, immediate resuscitative thoracotomy is indicated and should not be delayed for diagnostic confirmation. Survival from cardiac tamponade is highly time-dependent, with no survivors observed when thoracotomy occurred more than 15 minutes after arrest, and survival rates decreasing steeply even within that window.(52) Ultrasound may assist in identifying tamponade, but any delay to intervention in a time-critical arrest reduces the likelihood of survival. In this case, performing PHUS before thoracotomy likely contributed to the missed window for successful resuscitation.

Appendix D - Hierarchy of evidence & grading of recommendations

Hierarchy of Evidence

Level of evidence	Type of evidence
Ia	Evidence from systematic reviews or meta-analysis of randomised controlled trials
Ib	Evidence from at least one randomised controlled trial
IIa	Evidence from at least one controlled study without randomisation
IIb	Evidence from at least one other type of quasi experimental study
III	Evidence from non-experimental descriptive studies such as comparative studies, correlation studies and case-control studies
IV	Evidence from expert committee reports or opinions and/or clinical experience of respected authorities

Grade of recommendation	Type of evidence
A	Based on hierarchy I evidence
B	Based on hierarchy II evidence or extrapolated from hierarchy I evidence
C	Based on hierarchy III evidence or extrapolated from hierarchy I or II evidence
D	Directly based on hierarchy IV evidence or extrapolated from hierarchy I, II or III evidence

Shekelle PG, Woolf SH, Eccles M, et al. (1999). Clinical guidelines: developing guidelines. *BMJ: British Medical Journal*. Feb 27;318(7183):593.

Appendix E - Authors

(JS) Dr James Sen MBChB MSc (medical ultrasound) MRCP FRCA FFICM FIMC RCSEd.

Consultant in Anaesthetics & Intensive Care Medicine, Leeds Teaching Hospitals Trust

Pre-hospital Doctor at The Air Ambulance Service & Yorkshire Air Ambulance

(CE) Dr Christopher Edmunds MBChB, FRCEM, FFICM, FIMC RCSEd, DipMIM

Consultant Emergency Medicine, Intensive Care Medicine and Pre-hospital Emergency Medicine, Northwest Anglia Foundation Trust and East Anglian Air Ambulance.

Transfer Consultant at East of England Adult Critical Care Transfer Service.

Co-Chair RCEM PHEM Professional Advisory Group

(RM) Dr Roderick Mackenzie MB BCHir PhD FRCEM FRCP FIMC RCSEd

Consultant in Emergency Medicine and Pre-hospital Emergency Medicine, Cambridge University Hospitals

(CS) Mr Carl Smith BEM MSc DIMC DMIM RCSEd MCPara

Advanced Clinical Practitioner (Critical Care), East of England Ambulance NHS Trust

Head of Clinical Development Emergency and Critical Care, College of Paramedics

(NS) Dr Nick Smallwood MBChB

Consultant Acute Medicine, Hampshire Hospitals NHS Foundation Trust

Chair FAMUS Working Group

(SS) Ms Samantha Sweeney PGCert DIMC RCSEd

Critical Care Paramedic, East Anglian Air Ambulance & East of England Ambulance Service

(CH) Dr Charlotte Haldane MBChB MRCEM DiMM FIMC RCSEd
HEMS Consultant, North West Air Ambulance
Locum Consultant, Paediatric and Neonatal Decision Support and Retrieval
Service, Cambridge University Hospitals
HEMS Doctor, Magpas Air Ambulance
Chair of Clinical Standards, FPHC

(SC) Prof Simon Carley FRCEM MPhil MD PhD
Consultant Emergency Medicine, Manchester NHS Trust
Consultant in Enhanced Prehospital Care, North West Air Ambulance
MAHSC Professor, University of Manchester
Dean Royal College of Emergency Medicine

(MP) Dr Marcus Peck MBBS MRCP FRCA FFICM
Consultant in Anaesthetics & Intensive Care Medicine, Hampshire Hospitals
Network Lead for ICS FUSIC committee

(CY) Dr Chris Yap MBChB FRCEM Dip (medical ultrasound)
Consultant Emergency Medicine, Sheffield Teaching Hospitals
RCEM POCUS sub-committee Chair

Declarations:

MP has received honoraria for teaching from GE, Echonous and FujiFilm.
RM is the Vice Chair of the IBTPHEM
CY has received honoraria for teaching from GE and FujiFilm.

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Summary of Recommendations

- 1. Clinicians should only use pre-hospital diagnostic ultrasound to answer a focused question, where the answer will alter the pre-hospital clinical management, and not delay time-critical interventions both pre-hospital and in hospital [Grade D]**
- 2. Procedural application of ultrasound should only be used where it facilitates or enhances timely intervention and can be performed without unnecessarily delaying essential care or transport [Grade D]**
- 3. Clinicians must recognise the technical and environmental limitations of PHUS and incorporate these into interpretation and decision-making [Grade C]**
- 4. Clinicians from diverse backgrounds, including paramedics and other allied healthcare professionals, can undertake PHUS autonomously where governance structures support appropriate training, assessment and ongoing oversight [Grade D]**
- 5. Pre-hospital services using ultrasound must have a nominated clinical lead with responsibility for the oversight and governance of PHUS [Grade D]**
- 6. Clinically relevant images and videos must be securely stored for quality assurance purposes, with appropriate data governance. Any interpretation and decision making should be clearly documented in the clinical record [Grade D]**
- 7. Pre-hospital organisations must ensure that PHUS use is subject to a defined governance framework that includes quality assurance and quality control processes [Grade D]**
- 8. Choice of ultrasound equipment should be appropriate to its intended use. It must be serviced regularly and kept up to date in accordance with local and manufacturer policy [Grade D]**
- 9. Infection control measures must be adhered to at all times [Grade C]**
- 10. Each organisation must ensure that clinicians performing PHUS are assessed as competent in each examination type by a suitably qualified and experienced PHUS trainer [Grade D]**

- 11. During training or development towards independent PHUS practice, all scans should be reviewed by a supervisor within a clinically relevant timeframe [Grade D]**
 - 12. To maintain competency in PHUS clinicians should complete regular CPD and be able to demonstrate regular practice [Grade D]**
 - 13. Organisations delivering PHUS must ensure that systems are in place for the governance, supervision, and quality assurance of both training and independent clinical use [Grade D]**
 - 14. Organisations must provide access to training opportunities which ensure clinicians develop competencies that match their clinical requirements [Grade C]**
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