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 ultrasound for gastroenterological indications
Topic exploration report number:	TER175

Introduction and aims

Health Technology Wales researchers searched for evidence on point-of-care hand-held ultrasound devices in addition to standard of care compared with formal ultrasound in radiology departments for gastroenterological investigations. Point-of-care ultrasound could be implemented in gastroenterology outpatient clinics, accident and emergency departments, medical admissions units and GP surgeries to investigate for issues such as gall stones, fatty liver and focal lesions in the liver. For the purposes of this Topic Exploration Report, Health Technology Wales researchers only investigated the use of point-of-care ultrasound for gastroenterological indications.

Summary of evidence

Guidelines and guidance

Health Technology Wales researchers did not identify any UK guidelines or guidance which focused on point-of-care ultrasound. The European Society of Radiology (ESR) states that portable ultrasound devices using different ultrasound techniques (colour Doppler US and PW-Doppler) could be used by different healthcare professionals for abdominal, cardiac, lung, obstetric, paediatric, vascular and trauma scanning. ESR states that 'portable devices can considerably reduce the overall time required for performing an ultrasound examination at the bedside' and that portable ultrasound devices are effective… but will not replace a high-resolution US examination'. ESR further notes that patient safety and high standards of hygiene must be maintained and that adequate image and report storage are mandatory.

Systematic reviews

One relevant Cochrane review was identified. The review aimed to establish the diagnostic accuracy of point-of-care ultrasonography for detecting and excluding free fluid, organ injuries, vascular lesions and other injuries compared with a diagnostic reference standard

(i.e. computed tomography (CT), magnetic resonance imaging (MRI), thoracoscopy or theoracotomy, laparoscopy or laparotomy, autopsy or any combination of these in people with blunt thoracoabdominal trauma. 34 studies were included in the review, with a total of 8,635 people. Across all relevant studies, the review reports summary estimates of sensitivity of 0.74 (95% confidence intervals 0.65 to 0.81) and specificity of 0.96 (95% confidence intervals 0.94 to 0.98), although the authors noted substantial heterogeneity across studies with diagnostic accuracy varying depending on the population and affected body area. For abdominal trauma, point-of-care ultrasonography had a sensitivity of 0.68 (95% confidence interval 0.59 to 0.75) and a specificity of 0.95 (95% confidence interval 0.92 to 0.97).

We identified a further 13 systematic reviews covering indications including abdominal trauma, appendicitis, intussusception, gallstones, kidney stones, abdominal aortic aneurysm and ascites. These reported outcomes including sensitivity, specificity, positive predictive value and negative predictive value.

Three systematic reviews considered trauma. The most recent systematic review (Botker et al, 2018) focused on the use of point-of-care ultrasound in pre-hospital critical care. 27 studies were included in the systematic review, though no studies compared patient outcome with and without pre-hospital point-of-care ultrasound. Of the 27 studies, four studies of acceptable quality demonstrated feasibility and changes in patient management in trauma. The systematic review also considers the implementation of point-of-care ultrasound, reporting that two studies demonstrated that short teaching sessions are sufficient for obtaining interpretation skills but not image acquisition, while three studies of acceptable quality found that longer one or two day courses including hands-on training are sufficient for learning simple image acquisition skills.

Nishijima et al, (2012) included 12 studies which reported the precision and accuracy of symptoms, signs, laboratory tests and bedside imaging studies to identify intra-abdominal injuries in people with blunt abdominal trauma found that beside ultrasonography had the highest accuracy, but that a normal result does not rule out an intra-abdominal injury.

The third systematic review (Jorgensen et al 2010) found that there was no evidence in the literature that pre-hospital ultrasound of the abdomen or thorax improves the treatment of trauma patients. It did however identify several studies which found that pre-hospital ultrasound is reliable in the detection of haemoperitoneum or haemopericardium compared with physical examination and haemodynamic measurements.

A further systematic review (Beggs & Thomas, 2013) of point-of-care ultrasound undertaken by surgeons or non-radiologists using portable equipment in a range of populations found that there was ‘moderately good evidence for the routine use of ultrasound by surgeons at the bedside for gallbladder, thyroid, parathyroid, DVT scanning and trauma scanning.’

Four systematic reviews considered the population of suspected acute appendicitis. The most recently published systematic review (Lee & Yun, 2019) considered point-of-care ultrasonography performed by an emergency physician for acute appendicitis. The review included 17 studies (2,385 people) and found a sensitivity of 0.84 (95% confidence interval 0.72 to 0.92) and a specificity of 0.91 (95% confidence interval 0.85 to 0.95). A direct comparison revealed no significant differences (p=0.18-0.85) between the diagnostic performances of emergency physician-performed point-of-care ultrasound and radiology-performed ultrasound.

A systematic review (Fields et al, 2017) considered the diagnostic accuracy of point-of-care trans-abdominal ultrasound, performed by a non-radiologist physician, in the diagnosis of

acute appendicitis. The review included 21 studies published up to May 2015. The sensitivity and specificity were reported to be 0.91 (95% confidence interval 0.83 to 0.96) and 0.97 (95% confidence intervals 0.91 to 0.99), respectively. The positive and negative predictive values were 91 and 94%. The study also reported diagnostic accuracy when point-of-care ultrasound was performed by emergency physicians. The sensitivity was 0.8 and the specificity was 0.92.

One systematic review (Benabbas et al, 2017) focused on the diagnostic accuracy of history, physical examination, laboratory tests, Paediatric Appendicitis Score and point-of care ultrasound for diagnosis of paediatric acute appendicitis in the emergency department. 21 studies were included, published before October 2016.

One systematic review (Carroll et al, 2013) compared surgeon-performed ultrasound with pathological examination or radiologist-performed ultrasound for suspected appendicitis or gallstone disease. Eight studies were included. The study found a pooled sensitivity of 0.92 and specificity of 0.96.

One systematic review by (Ross et al, 2011) considered the diagnostic accuracy of bedside emergency physician-performed ultrasound for cholelithiasis. Point-of-care ultrasound was compared with radiology-performed ultrasound, CT, MRI or surgical findings. Eight studies were included and the pooled sensitivity and specificity were found to be 0.898 (95% confidence interval 0.864 to 0.925) and 0.88 (95% confidence interval 0.864 to 0.925).

One systematic review (Wong et al, 2018) considered the diagnostic accuracy of point-of-care ultrasound by emergency physicians for nephrolithiasis. Nine articles were included in the systematic review and five high quality studies were included in the meta-analysis for diagnostic accuracy. Pooled sensitivity was 0.702 (95% confidence interval 0.671 to 0.732) and specificity was 0.754 (95% confidence interval 0.725 to 0.782).

One systematic review (Tsou et al, 2019) included 30 studies which considered the diagnostic accuracy of point-of-care ultrasound undertaken by emergency medicine physicians compared with radiology-performed ultrasound for intussusception. The study reported that the sensitivity of ultrasonography for intussusception is 0.98 (95% confidence intervals 0.96 to 0.98) and the specificity is 0.98 (95% confidence intervals 0.95 to 0.99). The systematic review found that meta-regression suggested no significant difference between point-of-care ultrasound and radiology-performed ultrasound for intussusception.

A systematic review (Liu et al, 2017) looked at implementation issues surrounding the use of point-of-care ultrasonography to detect fluid. The study states that ‘even in inexperienced hands, [point-of-care ultrasound] has shown to be more sensitive than physical examination for conditions such as ascites, pleural effusion and pericardial effusion’.

One study (Concannon et al, 2014) considered the diagnostic accuracy of non-radiologist-performed ultrasounds, compared with radiologist-performed aortic imaging, intra-operative findings or post-mortem findings for abdominal aortic aneurysm. 11 studies were included and found that non-radiologist performed ultrasound had a sensitivity of 0.975 (95% confidence interval 0.942 to 0.992) and a specificity of 0.989 (95% confidence interval 0.979 to 0.995).

A systematic review (Bainbridge et al, 2018) looked at perioperative ultrasound for diagnosing issues related to the heart, lungs, stomach and airway. 80 articles were included. Diagnostic accuracy was not reported in the abstract of the review, though it notes that few trials reported on patient outcomes.

Health economic studies

A cost analysis of the STONE randomised controlled trial (Melnikow et al, 2016) in people with suspected kidney stones presenting at the emergency department found that total costs were not significantly different between people who received point-of-care ultrasound, radiology ultrasound or CT. Total costs comprised initial emergency department visit costs and all costs accrued over seven days following enrolment.

One cost benefit analysis (Van Schaik et al, 2019) from the US perspective considered point-of-care ultrasound as part of emergency medicine. Emergency department physicians were interviewed when point-of-care ultrasound was used on the role of the test in clinical management and on subsequent tests avoided. Cost savings were then attributed to these savings. The study found that point-of-care testing eliminated $1,134 through tests averted for privately insured patients, $2,826 for uninsured patients and $182 for Center for Medicare and Medicaid Services patients. The study abstract reports that aggregate cost savings remained significant when point-of-care ultrasound events which did not result in a change in management were included in the analysis. It is unclear whether the cost of the point-of-care ultrasounds cost is included in the analysis.

One systematic review (Carroll et al, 2013), noted above, considered surgeon-performed ultrasound for the detection of appendicitis and gallstones. It reported that data regarding cost-effectiveness are lacking.

Areas of uncertainty

Evidence is available on the use of point-of-care ultrasonography in many indications. If a fuller review were undertaken, this would need to focus on the indications where advice is most likely to be required and to be useful.

The definitions of 'point of care' ultrasound vary and this can cover a range of devices from portable but still relatively large units to hand-held devices. It is not clear whether evidence on these is comparable or whether any further assessment should focus on one particular class of device.

Conclusions

No UK clinical guidelines were identified which specifically refer to point-of-care ultrasound. One Cochrane Review and several systematic reviews were identified which considered a range of clinical indications. The systematic reviews included indications such as appendicitis, gall stones, kidney stones, intussusception, ascites, trauma and abdominal aortic aneurysm. The systematic reviews themselves included large numbers of primary studies, indicating that there is a large amount of research regarding point-of-care ultrasound. However, it is unclear whether there is evidence on the effect of point-of-care ultrasound on patient outcomes (a more detailed search would be needed to identify this, which is beyond the scope of this report). One systematic review noted that four studies reported on change in patient management for trauma.

One cost analysis was identified, which considered point-of-care ultrasound for people in the USA with suspected kidney stones. One cost benefit analysis from the USA perspective

considered point-of-care ultrasound use in the emergency department, and did not specify a population.

Brief literature search results

Resource	Results
HTA organisations	
Healthcare Improvement Scotland	We did not identify any relevant evidence using the following search terms: • Point of care ultrasound • Hand-held ultrasound • Ultrasound • Hand-held Doppler
Health Technology Assessment Group	We did not identify any relevant evidence using the following search terms: • Point of care ultrasound • Hand-held ultrasound • Ultrasound • Hand-held Doppler
Health Information and Quality Authority	We did not identify any relevant evidence using the following search terms: • Point of care ultrasound • Hand-held ultrasound • Ultrasound • Hand-held Doppler
UK guidelines and guidance	
SIGN	We did not identify any relevant evidence using the following search terms: • Point of care ultrasound • Hand-held ultrasound • Hand-held Doppler
NICE	We did not identify any relevant evidence using the following search terms: • Point of care ultrasound • Hand-held ultrasound • Hand-held Doppler • Butterfly iQ
Secondary literature and economic evaluations	
EUnetHTA	We did not identify any relevant evidence using the search term ‘ultrasound’
Cochrane library	6 Cochrane Reviews matched the search term ‘hand-held ultrasound’ though none were deemed relevant based on their titles 13 Cochrane Reviews matched the search term ‘point of care ultrasound’. One systematic review was identified:

	Cochrane Database of Systematic Reviews Point-of-care ultrasonography for diagnosing thoracoabdominal injuries in patients with blunt trauma Cochrane Systematic Review - Diagnostic Version published: 12 December 2018 https://doi.org/10.1002/14651858.CD012669.pub2
Medline	• Diagnostic performance of emergency physician-performed point-of-care ultrasonography for acute appendicitis: A meta-analysis. Lee SH; Yun SJ. American Journal of Emergency Medicine. 37(4):696-705, 2019 04 • Accuracy of Point-of-care Ultrasonography for Diagnosing Acute Appendicitis: A Systematic Review and Meta-analysis. [Review] Matthew Fields J; Davis J; Alsup C; Bates A; Au A; Adhikari S; Farrell I. Academic Emergency Medicine. 24(9):1124-1136, 2017 09. • Diagnostic Accuracy of History, Physical Examination, Laboratory Tests, and Point-of-care Ultrasound for Pediatric Acute Appendicitis in the Emergency Department: A Systematic Review and Meta-analysis. [Review] Benabbas R; Hanna M; Shah J; Sinert R. Academic Emergency Medicine. 24(5):523-551, 2017 05 • Surgeon-performed ultrasound at the bedside for the detection of appendicitis and gallstones: systematic review and meta-analysis. [Review] Carroll PJ; Gibson D; El-Faedy O; Dunne C; Coffey C; Hannigan A; Walsh SR. American Journal of Surgery. 205(1):102-8, 2013 Jan. • Accuracy of point-of-care ultrasound and radiology-performed ultrasound for intussusception: A systematic review and meta-analysis. Tsou PY; Wang YH; Ma YK; Deanehan JK; Gillon J; Chou EH; Hsu TC; Huang YC; Lin J; Lee CC. American Journal of Emergency Medicine. 37(9):1760-1769, 2019 09 • The role of point of care ultrasound in prehospital critical care: a systematic review. [Review] Botker MT; Jacobsen L; Rudolph SS; Knudsen L. Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine. 26(1):51, 2018 Jun 26. • The Accuracy and Prognostic Value of Point-of-care Ultrasound for Nephrolithiasis in the Emergency Department: A Systematic Review and Meta-analysis. Wong C; Teitge B; Ross M; Young P; Robertson HL; Lang E. Academic Emergency Medicine. 25(6):684-698, 2018 06. • A review of diagnostic accuracy and clinical impact from the focused use of perioperative ultrasound. [Review] Revue de l'exactitude diagnostique et de l'impact clinique de l'utilisation ciblee de l'echographie perioperatoire. Bainbridge D; McConnell B; Royse C. • The Practice and Implications of Finding Fluid During Point-of-Care Ultrasonography: A Review. [Review] Liu RB; Donroe JH; McNamara RL; Forman HP; Moore CL. JAMA Internal Medicine. 177(12):1818-1825, 2017 12 01

	• Diagnostic accuracy of non-radiologist performed ultrasound for abdominal aortic aneurysm: systematic review and meta-analysis. [Review] Concannon E; McHugh S; Healy DA; Kavanagh E; Burke P; Clarke Moloney M; Walsh SR. International Journal of Clinical Practice. 68(9):1122-9, 2014 Sep • Point of use ultrasound by general surgeons: review of the literature and suggestions for future practice. [Review] Beggs AD; Thomas PR. International Journal Of Surgery. 11(1):12-7, 2013 • Does this adult patient have a blunt intra-abdominal injury?. Nishijima DK; Simel DL; Wisner DH; Holmes JF. JAMA. 307(14):1517-27, 2012 Apr 11. • Emergency physician-performed ultrasound to diagnose cholelithiasis: a systematic review. [Review] Ross M; Brown M; McLaughlin K; Atkinson P; Thompson J; Powelson S; Clark S; Lang E. Academic Emergency Medicine. 18(3):227-35, 2011 Mar. • Does prehospital ultrasound improve treatment of the trauma patient? A systematic review. [Review]Jorgensen H; Jensen CH; Dirks J. European Journal of Emergency Medicine. 17(5):249-53, 2010 Oct. • Cost Analysis of the STONE Randomized Trial: Can Health Care Costs be Reduced One Test at a Time?. Melnikow J; Xing G; Cox G; Leigh P; Mills L; Miglioretti DL; Moghadassi M; Smith-Bindman R. Medical Care. 54(4):337-42, 2016 Apr • Point-of-Care Ultrasonography (POCUS) in a Community Emergency Department: An Analysis of Decision Making and Cost Savings Associated With POCUS. Van Schaik GWW; Van Schaik KD; Murphy MC. Journal of Ultrasound in Medicine. 38(8):2133-2140, 2019 Aug
Other	
Evidence supplied by the topic proposer	https://www.butterflynetwork.com/evidence Relevant publications listed on butterflynetwork.com: Session EA19-1 Perioperative Medicine I. A1092 / Monitor 04 – Point of Care Ultrasound Evaluation in the Postanesthesia Unit: A Multicenter Prospective Observational Study. Anesthesiology 2019 October 19-23 Orlando. ESR Statement on portable ultrasound devices. European Society of Radiology, 16 September, 2019. Insights into Imaging volume 10, Article number: 89 (2019)

Date of search:	April 2020
Concepts used:	Point of care ultrasound; hand-held ultrasound; ultrasound; butterfly iQ; hand-held doppler