Appendix 2: Evaluation of ultrasound competences

Each participating GP was invited to a one-hour individual meeting 1-16 days prior to the beginning of the data collection. In this meeting, the participating GP was introduced to the data collection tools and the study procedure by the principal investigator. Additionally, each GP participated in individual session where their ultrasound competences were evaluated by a radiologist.

Evaluation procedure

In the evaluation session, GPs were asked to perform ultrasound examinations, as they would normally perform them in their own clinic. GPs were provided with the opportunity to use their own ultrasound device or one of four midrange ultrasound devices: (1) The ACUSON P500 Ultrasound System from Siemens Healthcare (Erlangen, Germany), (2) The Flex Focus 400 from BK Medical Holding Company (Herlev, Denmark), (3) The M-Turbo® ultrasound system from FUJIFILM SonoSite (Bothell, USA) or (4) The LOGIQ P9 from GE Healthcare (Chicago, USA). Ultrasound examinations were performed on healthy volunteers (medical students or a soldier) and a gynecological phantom.

For this study, we used assessment tool developed and used in the certification of general practitioners following an ultrasound course[1]. These assessment tool included evaluation of ultrasound competences within the following applications: Heart (FATE protocol[2]), lung (LUS protocol[3]), Abdominal (including FAST protocol[4] and focused assessment of the gallbladder (Cholecystitis, gallstones), kidneys (hydronefrosis), bladder(residual urine) and aorta(abdominal aortic aneurism)), deep venous thrombosis (2-point-compression protocol[5]), musculoskeletal (focused assessment of joints, tendons and muscles) and gynaecological (location of intrauterine device, Location of intrauterine foetus, detection of foetal heartbeat, head position in third trimester, detection of fluid in fossa douglasi). The participating GPs used a range of different ultrasound applications during their daily clinical work. Some more than others. GPs were only asked to demonstrate ultrasound examinations within applications that they used during their daily clinical work.

The evaluation sessions included assessment of one ultrasound application after another. The participating GPs demonstrated their ultrasound competences by scanning healthy volunteers (and/or a transvaginal ultrasound training phantom) while a radiologist assessed their skills and asked questions about the examination. After each demonstration, the participants were presented with two application-specific clinical cases from general practice including ultrasound videos with pathology. The participants were then asked to interpret the videos and integrate the findings into the context of the case.

Assessment tools

After this scanning sessions the radiologist evaluated the participants' ultrasound competences for each application using a modified version of the generic ultrasound rating scale *The Objective Structured Assessment of Ultrasound Skills* (OSAUS)[6] and an *objective structured clinical examination* (OSCE)[7].

The generic OSAUS evaluation included assessment (rated on a scale: 1-5 points) of the participants': (1) knowledge of the indication for the examination, (2) applied knowledge of ultrasound equipment, (3) performed image optimization), (4) systematic approach while performing the examination, (5) ability to Interpret images, (6) documentation of the examination, and (7) medical decision making. The generic OSAUS score was adapted to a general practice setting by removing assessment of participant's ability to document ultrasound images, as the GPs were unable to document ultrasound images in their

medical record system. Additionally, the generic scale was extended with two clinical cases from general practice to further assess the clinical decision making (rated on a scale: 1-5 points). Hence, the adapted OSAUS score included a scale from 0-40 points.

The OSCE evaluation was designed to evaluate the participants' clinical skill performance. The radiologist gave the participants marks on a mark scheme for each step that they perform correctly. Based on the marks, the radiologist made an overall evaluation of each participant for each applications (passed/not passed).

The evaluation of the participants' ultrasound competences resulted in an individual OSAUS score (0-40 points) and an individual passed/not passed OSCE result for each application. The participating GPs were blinded to the results of this evaluation.

OSAUS evaluation

Application: _____

Indication for the examinations	**1**	**2**	**3**	**4**	**5**
If applicable. Reviewing patient history and knowing why the examination is indicated.	Displays poor knowledge of the indication for the examination		Displays some knowledge of the indication for the examinations		Displays ample knowledge for the examination
Applied knowledge of ultrasound equipment	**1**	**2**	**3**	**4**	**5**
Familiarity with the equipment and its functions i.e. selecting probe, using buttons and application of gel	Unable to operate equipment		Operates the equipment with some experience		Familiar with operating the equipment
Image optimization	**1**	**2**	**3**	**4**	**5**
Consistently ensuring optimal image quality by adjusting gain, depth, focus, frequency etc.	Fails to optimize images		Competent image optimization but not done consistently		Consistent optimization of images
Systematic examination	**1**	**2**	**3**	**4**	**5**
Consistently displaying systematic approach to the examination and presentation of relevant structures according to guidelines	Unsystematic approach		Displays some systematic approach		Consistently displays systematic approach
Interpretation of images	**1**	**2**	**3**	**4**	**5**
Recognition of image patterns and interpretation of findings	Unable to interpret any findings		Does not consistently interpret findings correctly		Consistently interpret findings correctly
Medical decision making	**1**	**2**	**3**	**4**	**5**
Ability to integrate scan results into the care of the patient and medical decision making	Unable to integrate findings into medical decision making		Able to integrate findings into a clinical context		Consistently integrates findings into medical decision making
Case 1	**1**	**2**	**3**	**4**	**5**
Case 2	**1**	**2**	**3**	**4**	**5**

OSCE evaluation of focused ultrasound assessment of the heart (FATE protocol)

	yes
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	

Setting-up the ultrasound equipment	
Is able to account for the selection of transducer	
Correct placement of transducer for Subcostal four chamber image	
Correct placement of transducer for Subcostal inferior vena cava image	
Correct placement of transducer for Apical four chamber image	
Correct placement of transducer for Parasternal long axis image	
Correct placement of transducer for Parasternal short axis image	
Correct placement of transducer for pleura image	
Is able to account for findings in relation to pericardial effusion	
Is able to account for findings in relation to cardiomyopathy	
Is able to account for findings in relation to reduced ejection fraction	
Is able to account for findings in relation to right ventricular stress	
Is able to account for findings in relation to the size of inferior vena cava.	
Is able to demonstrate a systematic approach in the examination	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
This ultrasound competence is approved	

OSCE evaluation of focused ultrasound assessment of the lung (FLUS-protocol)

	yes
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	
Setting-up the ultrasound equipment	
Is able to account for the selection of transducer	
Correct placement of transducer for anterior positions with the patient in the sitting position	
Correct placement of transducer for posterior positions with the patient in the sitting position	
Correct placement of transducer for anterior and lateral positions with the patient laying down	
Correct placement of transducer for posterior positions with the patient laying down	
Is able to account for findings in relation to the diagnosis and exclusion of pneumothorax	
Is able to account for findings in relation to the diagnosis and exclusion of interstitial syndrome	
Is able to account for findings in relation to the diagnosis and exclusion of pleura effusion	
Is able to account for ultrasound findings in patients with Chronic Obstructive Pulmonary Disease (COPD)	
Is familiar with procedure-related lung ultrasound	
Is able to demonstrate a systematic approach in the examination	
Is able to account for the impact of the patient position on the interpretation of the examination	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
Is able to give examples of dynamic changes in relation to pathological findings	
This ultrasound competence is approved	

OSCE evaluation of focused ultrasound assessment for deep vein thrombosis

(2-point compression protocol)

	Yes
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	
Correct position of patient	
Setting-up the ultrasound equipment	
Is able to account for the selection of transducer	
Correct placement of transducer for scanning proximal veins	
Correct placement of transducer for scanning veins in fossa poplitea	
Is able to account for findings that are diagnostic for deep vein thrombosis	
Is able to account for findings that rule-out deep vein thrombosis	
Is able to demonstrate a systematic approach in the examination	
Is able to account for typical locations of a thrombus in relation to deep vein thrombosis	
Is able to account for the importance of the patients position when interpreting images	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
This ultrasound competence is approved	

OSCE evaluation of focused ultrasound of the abdomen

(FAST protocol and focused assessment of Gallbladder, kidneys, aorta, bladder)

	yes
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	
Setting-up the ultrasound equipment	
Is able to account for the selection of transducer	
Correct placement of transducer for assessing aorta (detection of abdominal aortic aneurism)	
Correct measure of the abdominal aortic diameter	
Correct placement of transducer for assessning the gall bladder (gallstones and Cholecystitis)	
Correct demonstration of Murphys sign	
Correct measurement of gallbladder wall	
Correct placement of transducer for scanning kidneys and assessing hydronefrosis	
Is able to account for typical locations of hydronefrosis	
Correct placement of transducer for scanning bladder and assessing recidual urine	
Correct measure and calculation of bladder volume	
Correct placement of transducer for detection abdominal free fluid (ascites)	
Is able to account for free fluid in fossa hepatorenale, fossa splenorenale and fossa Douglasi / rectovesciale	

Is able to explain the effect of fasting for the outcome of the examination	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
Is able to provide examples of dynamic changes in relation to pathology on FAS-USS	
This ultrasound competence is approved	

OSCE evaluation of focused pelvic ultrasound

	yes
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	
Setting-up the ultrasound equipment	
Is able to account for the selection of transducer (both endovaginal and abdominal transducer)	
Correct placement of transducer for assessing uterus and ovaries	
Correct selection of transducer and correct placement of transducer for location IUD	
Correct selection of transducer and correct placement of transducer for detecting an intrauterine pregnancy	
Correct selection of transducer and correct placement of transducer for detecting an extra uterine pregnancy	
Correct selection of transducer and correct placement of transducer for detecting a fetal heart beat	
Correct selection of transducer and correct placement of transducer for estimation of gestational age (CRL)	
Correct selection of transducer and correct placement of transducer for detecting abdominal free fluid	
Is able to account for free fluid in fossa hepatorenale, fossa splenorenale and fossa Douglasi / rectovesciale	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
Is able to provide examples of dynamic changes in relation to pathological finding on pelvic ultrasound	
This ultrasound competence is approved	

OSCE evaluation of focused musculoskeletal ultrasound

	JA
Is able to account for indication and possible contraindications for performing the examination	
Adequate patient communication and preparation for the examination	
Setting-up the ultrasound equipment	
Is able to account for the selection of transducer	
Correct placement of transducer for assessing effusion surrounding the long head of the biceps muscle (caput longum biceps bracii)	
Correct placement of transducer for assessing tenosynovitis in the long head of the biceps muscle (caput longum biceps bracii)	
Correct placement of transducer for detection of inflammation in the bursa (bursitis subacromialis)	
Correct placement of transducer for detection of lateral epicondylitis (tennis elbow)	
Correct placement of transducer for assessing fluid accumulation in the knee (The suprapatellar bursa)	
Correct placement of transducer for detection of Patella Tendinopathy (Jumpers knee)	
Correct placement of transducer for assessing ligamentum patellae	
Correct placement of transducer for detection of Osgood-Schlatter	
Correct placement of transducer for detection of Achilles tendinitis	

Correct placement of transducer for detection of Achilles peritendinitis	
Correct placement of transducer for detection of rupture in the Achilles tendon	
Correct placement of transducer for detection of fascia plantaris tendinitis	
Is able to account for important pitfalls and limitations in relation to the examination.	
Is able to account for the consequences following normal ultrasound findings	
Is able to account for the consequences following pathological ultrasound findings	
Is able to provide examples of dynamic changes in relation to pathological finding on musculoskeletal ultrasound	
This ultrasound competence is approved	

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