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Point-of-care ultrasound training programme for internal medicine residents: the Triemli Blueprint

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Summary

Point-of-care ultrasound (POCUS) is a valuable addition to the diagnostic armamentarium of internal medicine specialists, improving patient assessment and treatment guidance. Early acquisition and continuous development of ultrasound skills during clinical training are key to maintaining the high quality of POCUS. In Switzerland, POCUS Component 1 (basics of emergency medicine ultrasound) of the Swiss Society of Ultrasound in Medicine (SGUM) postgraduate certification programme will be a mandatory component of board certification in General Internal Medicine (GIM) after 2026. Clinical institutions face the challenge of integrating POCUS teaching into daily practice. The following article addresses this challenge by describing the current regulatory conditions of POCUS training and presenting the POCUS training programme at Stadtspital Zürich Triemli as a blueprint for other postgraduate education sites in Switzerland.

Background

Point-of-care ultrasound (POCUS) represents a valuable addition to the diagnostic armamentarium of internal medicine specialists, improving patient assessment and treatment guidance. The numerous benefits of POCUS, including its speed, widespread availability, low cost, diagnostic integrity and high precision, position it as a highly valuable tool in narrowing the differential diagnosis in time-sensitive emergencies such as hypotension, shock or acute dyspnoea [1, 2]. It also facilitates assessing important dynamic changes and responses to treatment over time. The use of POCUS does not entail concerns about potential harm from ionising radiation or transportation of critically ill patients to different clinical units. Several studies have shown that procedures such as thoracentesis, paracentesis, arthrocentesis and catheter placements can be performed with reduced complication rates under sonographic guidance [3, 4]. Lastly, ultrasound appears to be a cost-effective imaging modality [5, 6].

The ability to address specific clinical questions, often on a dichotomised yes-or-no basis, facilitates the acquisition of appropriate skills. However, sufficient training is needed to achieve high quality in POCUS examinations. In 2022, the Swiss Institute for Postgraduate & Continuing Medical Education (SIWF/IFSM) decided that the POCUS Component 1 (basics of emergency medicine ultrasound) of the Swiss Society of Ultrasound in Medicine (SGUM) postgraduate certification programme will be mandatory for board certification in General Internal Medicine after 2026.

While this decision emphasises the growing importance of ultrasound skills for internal medicine specialists, it presents several challenges for teaching hospitals. First, there is a shortage of qualified instructors to educate and supervise all junior doctors completing board certification in General Internal Medicine. Secondly, clinical institutions are confronted with discussions about the quality and safety of ultrasound examinations, as both the diagnostic and harm potentials are defined by the skills of the examiner and their supervisor. The creation of standard operating procedures and image quality control mechanisms is paramount to ensure the reliability of diagnostic results. These processes are time-consuming, necessitating additional staffing and resource allocation.

To coordinate the efforts and capacities of all internists throughout Switzerland, an interest group for ultrasound in internal medicine (USIM) was formed on behalf of the Swiss Society of General Internal Medicine (SSGIM) to promote ultrasound within the scope of the General Internal Medicine and coordinate their activities with the SGUM. The USIM convenes at least twice annually at the SSGIM meetings for professional exchange and to address emerging challenges with a bottom-up approach. The USIM is responsible for planning and coordinating ultrasound activities in General Internal Medicine, developing an educational online platform and organising scientific events and training sessions biannually.

Significant variation in physicians' practical experience and sonographic competencies has been observed across individuals, specialities and regions in Switzerland [7, 8]. The lack of standardised educational programmes during the six-year undergraduate medical education period means that the current generation of internal medicine physicians in Switzerland must acquire ultrasound skills during their residency. Historically, this has been undertaken voluntarily and was contingent on the local practice of the individual clinical institution. As the field of General Internal Medicine has evolved and become increasingly complex, junior physicians depend on the mentoring and guidance of their senior colleagues in planning their post-

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graduate education. Consequently, senior physicians assume a pivotal role in fostering, advocating for and practising ultrasound examinations. Currently, there is a notable deficit in senior physicians' training in POCUS. The implementation of a structured training programme has the potential to address this gap by providing a standardised, high-quality ultrasound training curriculum for residents and senior doctors in General Internal Medicine.

Blueprint for a structured POCUS Training Curriculum

In Stadtspital Zürich Triemli, a hands-on, peer-led ultrasound educational programme was initiated in 2022, aiming to promote a positive ultrasound teaching culture and enable all internal medicine specialists in the local General Internal Medicine division to acquire the necessary skills and complete the supervised exams required for the POCUS certificate. The blueprint for this programme is shared in the appendix tables S1 and S2 for use by other institutions. The template proposed here is designed to serve as a basis for a standardised education plan that is easily accessible, constantly optimised and adapted. We understand it as a guide to complement the formal training obtained during SGUM courses.

This programme is based on the official SGUM syllabus for POCUS Component 1 with 10 teaching topics, including the 13 essential learning objectives (appendix table S1) and additional learning objectives (appendix table S2) for advanced sonographers. Each teaching topic is organised with two hands-on teaching sessions, spanning half a year (table S1) or one year (table S2). These sessions are led by consultants from various medical disciplines, including radiology, gastroenterology and hepatology, pneumology, cardiology, rheumatology and angiology, as well as already trained and experienced residents and senior internists (figure 1).

The additional objectives listed in table S2 are not mandatory for certification in POCUS Component 1. In addition to the learning objectives of other POCUS components – such as focused cardiac ultrasound (Component 13) and lung ultrasound (Component 11) – table S2 also includes objectives for the Certificate of Sonography (Module Abdomen). These objectives involve more descriptive or exploratory questions and examinations, which are beyond a binary answer and require instructors with advanced training and expertise. We consider a basic understanding of these objectives essential for advanced residents, as proficiency in ultrasound relies on recognising organs and structures, which is not fully addressed by POCUS Component 1. Additionally, focused cardiac and lung ultrasound are increasingly integrated in emergency care. Several senior General Internal Medicine physicians at Stadtspital Zürich Triemli are certified for Sonography (Abdomen). Moreover, expertise from other disciplines and supervision of Components 11 and 13 is available. As such, our programme also includes advanced topics (table S2). In a setting with limited skills and resources, the topics in table S1 are sufficient for Component 1 certification.

Before each teaching session, all residents of General Internal Medicine receive an email containing the learning objectives and educational videos and images. This preparation ensures familiarity with the topic and reactivation of existing knowledge. Each teaching session begins with a short theoretical presentation, followed by a 30-minute hands-on guided training session in small groups. Scan-

Figure 1: Structured teaching of point-of-care ultrasound skills: Weekly hands-on learning sessions under the instruction of consultants and experienced internists.

ning is performed on each other or selected patients with interesting pathological findings who consent to participate. For each training session, one supervised ultrasound is accredited. Supplementary learning materials, subject-specific presentations and e-learning courses on POCUS Component 1 and abdominal sonography, developed by the Institute of Primary Health Care Bern (BIHAM), are available on the intranet for residents and free to access at any time.

Supervision and ultrasound round

To obtain the certification for POCUS Component 1 of the SGUM program, trainees must complete a logbook with 200 patient examinations, of which 100 must be supervised. To address this challenge, optional short daily supervised ultrasound rounds have been implemented: residents inform the coordinator of these sessions via a designated ultrasound phone after daily ward rounds. Pathological sonographic findings are then reviewed together in the afternoon. Such an approach provides 2–3 supervised examinations for all participants, where findings can be discussed and interpreted in a clinical context.

The combination of weekly ultrasound training sessions and supervised ultrasound rounds has enhanced the performance of ultrasound within General Internal Medicine, fostering greater confidence and competence among both residents and senior physicians, ultimately improving patient care through timely and accurate diagnoses. The interdisciplinary nature of this programme has led to a widespread acceptance of our ultrasound curriculum across various divisions of our hospital, further promoting a familiar interdisciplinary collaboration and dynamic exchange during regular work hours.

Outlook

POCUS is being increasingly recognised as an indispensable tool in internal medicine, and distinct clinical skills in POCUS will be required for board certification in General Internal Medicine. The future of POCUS lies in its continued integration into routine clinical practice. To facilitate this, there is a need for a robust framework and standardisation in the education and supervision of residents. Standardised training programmes, such as the one provided here, are essential to ensure the safe and effective use of POCUS, thereby consolidating its position as a cornerstone of modern internal medicine.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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Appendix

The Triemli Point-of-Care Ultrasound Learning Curriculum

Table S1. POCUS Basics (Module 1)

Session	Teaching subject	Learning objectives
1	Basic principles of ultrasound technique and image optimization	- Understanding basic physical principles of ultrasound imaging (piezoelectric effect, characteristics of sound waves, image acquisition) - Familiarize the features and possibilities of the available ultrasound machine (Different ultrasound probes, pre-sets, permanently storing image and video material in electronic system) - Optimizing image acquisition regulating the gain, TGC, frequency, depth, focus, dynamic range and device pre-sets - Recognizing the most frequently occurring artefacts including reverberation, shadowing, attenuation, enhancement, edge artefacts, refraction, mirroring, Doppler artefacts - **Limitations of POCUS basics of emergency medicine ultrasound**
2	Kidneys and Bladder	- Recognizing signs of **hydronephrosis** - Learning to assess the **bladder volume**
3	Lung ultrasound	- Knowledge of the artifacts (A-lines, B-lines, comet tails) as variables to be interpreted in lung ultrasound as well as the indication when to switch of the device setting for artifact suppression - Learning to recognize and characterize **pleural effusions** (uncomplicated anechoic effusions vs. complicated effusions with septae, echogenic structures, pleural thickening etc.) - Knowing sonographic signs of a **pneumothorax** (absence of pleural sliding, barcode sign in M-Mode, absence of lung pulse, lung point) - Knowing sonographic signs of a **rip fracture** (cortical breach, small crescent of hematoma)
4	Trauma protocol: eFAST	- Learning to perform an eFAST in less than 1 minute assessing for **intraperitoneal free fluid** (Koller pouch, Morrison pouch, Excavatio rectovesicalis/Douglas pouch), **pericardial effusion** (subxiphoid view), **pleural effusion** and **pneumothorax** (anterior pleural views / left and right flank view)
5	Abdominal arteries	- Recognizing an **ectasy or aneurysm of the abdominal aorta**
6	Abdominal veins and assessing intravascular volume status	- Assessing volume status by scanning the Vena cava (Dilated >2.5 cm without respiratory changes and <1 cm and total inspiratory collapse) and knowing the limitations and gray area of this approach

7	2-point rule-out technique for deep venous thrombosis	- **Recognizing signs of deep venous thrombosis** (non-compressibility, lumen obliteration, absence of perfusion in Doppler sonography) at the junction of the common femoral and greater saphenous veins as well as the popliteal vein
8	Gall bladder and bile ducts	- Interpreting the thickness of the wall and content of the gall bladder in consideration of the last food intake - Recognizing the typical features **of gallstones and cholecystitis**
9	Soft tissue infections and abscesses	- Learning how **soft tissue infections and abscesses** appear in ultrasound
10	Ultrasound guided punctions and catheter placements	- Learning **sterile** technique with full aseptic barrier precautions in **ultrasound-guided punctures and catheter placements** with the example of establishing an intravenous access on a model arm (in-plane vs. out-of-plane technique)

Table S2. POCUS Advanced (Module 2)

Session	Teaching subject	Learning objectives – essentials in font
1	Basic principles of ultrasound technique and image optimization	- Understanding basic physical principles of ultrasound imaging (piezoelectric effect, characteristics of sound waves, image acquisition) - Familiarize the features and possibilities of the available ultrasound machine (Different ultrasound probes, pre-sets, permanently storing image and video material in electronic system) - Optimizing image acquisition regulating the gain, TGC, frequency, depth, focus, dynamic range and device pre-sets - Recognizing the most frequently occurring artefacts including reverberation, shadowing, attenuation, enhancement, edge artefacts, refraction, mirroring, Doppler artefacts - **Limitations of POCUS basics of emergency medicine ultrasound**
2	Abdominal arteries	- Understanding the Anatomy and identifying the following: Truncus coeliacus (A. hepatica communis, A. lienalis, A. gastrica sinistra), A. mesenterica superior, Aa. renales, Aa. iliacae: communes / externae (internae) - Recognizing an **ectasy or aneurysm of the abdominal aorta**
3	Abdominal veins and assessing intravascular volume status	- Understanding the anatomy and identifying the following: V. cava, V. lienalis, V. mesenterica superior, Sinus confluens venae portae, V. porta, Hepatic vein star - Assessing volume status by scanning the Vena cava (Dilated >2.5 cm without respiratory changes and <1 cm and total inspiratory collapse) and knowing the limitations and gray area of this approach
4	Liver	- Scanning the whole organ in its complex shape - Assessing echogenicity in comparison to the right renal cortex and knowing the limitations to this approach, homogeneity of the liver tissue, features of the surface and angle of the liver lobes - Recognizing signs of diffuse (cirrhosis, steatosis) and focal liver lesions and knowing to assign them to the corresponding liver segment (I-VIII) - Describing sonomorphologic features of focal lesions and formulate possible differential diagnosis
5	Gall bladder and bile ducts	- Interpreting the thickness of the wall and content of the gall bladder in consideration of the last food intake - Recognizing the typical features of **gallstones and cholecystitis** - Identifying and measuring the Ductus hepatocholedochus - Recognizing the double duct sign suggesting intrahepatic cholestasis

6	Pancreas and Spleen	- Scanning the pancreas using the V. lienalis as a guiding structure (transversal view / subcostal view). - Assessing the spleen and measure its size (in particular the longitudinal diameter). - Recognizing signs of diffuse (i.e. infiltrative processes) and focal spleen lesions as well as benign accessory spleens
7	Kidneys and adrenal glands	- Learning to assess kidney size, proportion of parenchyma versus pyelon, perfusion and outlet to urinary tract - Recognizing signs of **hydronephrosis**, nephrolithiasis and focal kidney lesions - Learning to identify the adrenal glands
8	Urinary tract	- Learning to assess the **bladder volume**, wall and dynamic influx of urine (urinary jets) - Recognizing signs of urolithiasis and foreign bodies (such as catheters, stents and pigtails)
9	Gastrointestinal tract	- Knowing the sonomorphologic features of the different segments of the gastrointestinal tract and consecutively correctly identifying the organs (oesophagus, stomach, duodenum, jejunum/ileum, appendix, colon ascendens/transversum/descendens/sigmoideum, rectum) - Recognizing the different wall layers (mucosa, muscularis mucosae, submucosa, muscularis propria, adventitia) in physiological and pathological state (inflammation, infiltration) - Identifying signs of acute appendicitis (diameter > 6mm, presence of an appendicolith, non-compressibility, hyperemia, perifocal reaction)
10	Female reproductive organs (uterus and adnexa)	- Identifying the uterus and ovaries and learning to assess whether the sonomorphologic features match the hormonal stage of the woman (menstruating or pre-/post-menopausal, anamnestic time point of the hormonal cycle) - Recognizing signs of an intra-/extrauterine pregnancy
11	Male reproductive organs (prostate, seminal vesicles and testicles)	- Assessing and measuring the volume of the prostate gland - Assessing the testicles including descent, perfusion and focal lesions and being able to identify important abnormalities such as acute testicular torsion
12	Lung ultrasound	- Knowledge of the artifacts (A-lines, B-lines, comet tails) as variables to be interpreted in lung ultrasound as well as the indication when to switch of the device setting for artifact suppression - Recognizing pleural irregularities/fragmentation and their importance for differentiating between B-lines and comet tails - Knowing the differential diagnosis of consolidations - Recognizing signs of pneumonia (consolidation with “hepatization” of the lung, aero-/fluidobronchogramm, increased blood circulation)

		- Learning to recognize and characterize **pleural effusions** (uncomplicated anechoic effusions vs. complicated effusions with septae, echogenic structures, pleural thickening etc.) - Knowing sonographic signs of a **pneumothorax** (absence of pleural sliding, barcode sign in M-Mode, absence of lung pulse, lung point) - Knowing sonographic signs of a **rip fracture** (cortical breach, small crescent of hematoma)
13	Emergency Echocardiography: subxyphoid view and apical four chamber view	- A4CH: Understanding the anatomy and recognizing the right atrium, right ventricle, left atrium, left ventricle, mitral and tricuspid valve - Learning to "eyeball" and identify striking abnormalities in wall motion and ejection fraction - Learning to identify striking abnormalities in valve function with Doppler sonography - Identifying signs of **pericardial effusion**
14	Emergency Echocardiography: parasternal long and short axis	- PSLA: Understanding the anatomy and recognizing the right ventricle, septum, left ventricle, LVOT, left atrium, mitral and aortic valve, sinus aorta, aorta ascendens and descendens - PSSA: Understanding the anatomy and recognizing the right atrium, right ventricle, left atrium, aortic valve, mitral valve, papillary muscles - Learning to "eyeball" and identify striking abnormalities in wall motion, ejection fraction - Identifying striking abnormalities in valve function with Doppler sonography - Identifying signs of **pericardial effusion**
15	Trauma protocol: eFAST	- Learning to perform an eFAST in less than 1 minute assessing for **intraperitoneal free fluid** (Koller pouch, Morrison pouch, Excavatio rectovesicalis/Douglas pouch), **pericardial effusion** (subxiphoid view), **pleural effusion** and **pneumothorax** (anterior pleural views / left and right flank view)
16	Ultrasound guided punctions and catheter placements	- Learning **sterile** technique with full aseptic barrier precautions in **ultrasound-guided punctures and catheter placements** with the example of establishing an intravenous access on a model arm (in-plane vs. out-of-plane technique)
17	2-point rule-out technique for deep venous thrombosis	- Recognizing signs of **deep venous thrombosis** (non-compressibility, lumen obliteration, absence of perfusion in Doppler sonography) at the junction of the common femoral and greater saphenous veins as well as the popliteal vein
18	Thyroid gland	- Learning the rare indications of performing an ultrasound of the thyroid gland - Learning to correctly measure the volume of the thyroid gland

		- Identifying focal lesions and learning to pay attention to their composition, echogenicity, shape, margins and echogenic foci in order to formulate an adequate action plan (according to TI-RADS criteria)
19	Basics of joint and soft tissue ultrasound	- Learning how normal muscular tissue, tendons (anisotropy), peripheral nerves, bones and cartilage appear in ultrasound - Recognizing joint effusions of the knee, shoulder and hip joint
20	Ultrasound of lymph nodes	- Recognizing benign vs. potentially worrisome features of lymph nodes (>10mm vs. <10mm in longitudinal diameter, almond-shaped vs. spherical/irregular shaped, presence vs. absence of benign fatty hilum sign, echogenicity, pattern of perfusion, location, sonographic appearance of neighboring lymph nodes)
21	Soft tissue infections and abscesses	- Learning how **soft tissue infections and abscesses** appear in ultrasound
22	Doppler and Contrast Enhanced Ultrasound (CEUS)	- Learning the principles of Doppler sonography (color Doppler, power Doppler, spectral Doppler) and how to optimize the image (PRF, angle) - Getting acquainted with theoretical principles of CEUS (contrast-enhanced ultrasound) and its increasing clinical use
23	Ultrasound of the eyeball	- Learning to assess the diameter of the optic nerve sheath and understanding swelling as a potential sign of raised intracranial pressure - Recognizing signs of retinal detachment or foreign bodies in the vitreous body