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Internal Medicine Residents' Experience with using Handheld Ultrasound Machines in Point-of-Care Ultrasonography

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REFLECTION

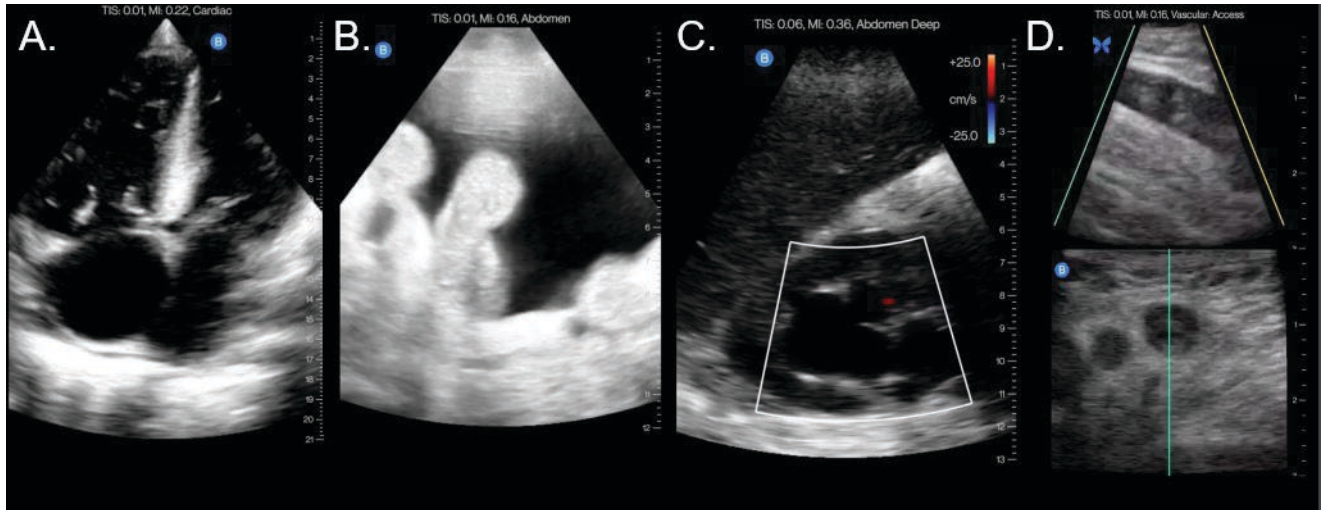
Point-of-care ultrasonography (POCUS) is defined as the acquisition and interpretation of ultrasonographic images generated by the clinician at the bedside. The advent of handheld machines has increased access and practical application of ultrasound technology in internal medicine training and medical education. The most common system involves a single portable ultrasound probe that connects to a smartphone or tablet, and storage of images are stored via cloud-based technology. We discuss our experience with POCUS using handheld ultrasound machines in the Thomas Jefferson University Hospital academic setting.

There are several benefits to having a handheld ultrasound machine as an Internal medicine resident. Immediate access to ultrasound technology has advantages in many settings, but especially in emergent settings such as rapid response alerts with critically ill patients in emergent situations. Specifically, POCUS imaging lung views (B-lines, pleural effusions, lung sliding, hepatization), global heart function, IVC collapsibility, vascular access are very helpful. In comparison, the process of moving the department ultrasound machine to the scene of a rapid response alert can take up to 10 minutes, assuming a machine is available. The clinical applications of POCUS as an adjunct to the physical exam and auscultation with a stethoscope has been emphasized by national groups; POCUS integration into diagnostic pathways allows for immediate visualization and results while avoiding radiation and high costs. There is an added benefit of increasing face to face time and direct patient care. The ability to store imaging on cloud services, which is a common service for the handheld ultrasound machines, also provides an opportunity for educational review and comparison with reference images.

An example of the use of POCUS as an Internal medicine resident: I responded to a rapid response alert to the dialysis unit, which is a setting in the hospital

that lacks many of the resources of the wards or critical care units. The alert was called for a 50 year old male in respiratory distress. He was admitted for hyperkalemia and he has a past medical history of end stage renal disease requiring thrice weekly dialysis as well as compensated heart failure. This was his first dialysis session after being admitted for hyperkalemia. The patient was feeling very short of breath and anxious. Chest x-ray was ordered but would take 10 minutes to arrive. The initial impression of the responders was that given the medical history, the patient was volume overloaded and the respiratory distress could be from flash pulmonary edema. On my exam, ultrasound of the lungs demonstrated only A-lines and normal lung sliding, with no B-lines or pleural effusions. In addition to the poor air movement and lack of significant rales on auscultation, the differential changed and favored bronchospasm. Treatment was started with albuterol- ipratropium. Later, chest XR confirmed the POCUS findings. Soon, the patient also started breaking out in an urticarial rash and continued shortness of breath with wheezing. Dialysis was stopped and he was treated with epinephrine, intravenous steroids, and antihistamines. Urgent labs and vascular access were also obtained by ultrasound guided venous access. Later we found that the patient was having an allergy to the dialysis filter, causing an anaphylactic reaction. The use of POCUS enabled immediate diagnostic information that changed our differential and prompted different treatment. Especially with the finding that the dialysis filter had been the reason for decompensation, if the original working diagnosis of flash pulmonary edema and volume overload had led to increasing the ultrafiltration rate on dialysis, then the patient could have further decompensated.

There are also barriers and disadvantages to use of handheld ultrasound machines in the inpatient setting. Unless trained, residents should not rely on POCUS in clinical decision making; it should only be used for educational purposes. What you see on an educational scan can prompt ordering "formal" imaging though.



Owning the machine alone doesn't replace an ultrasound tech, radiologist, and specialist experience. The opportunity to receive formal mentorship can be limited by faculty availability and access to the machines. The cost of the machine can also be prohibitive for individuals to purchase, ranging from \$2000 to \$5000.

The following clinical images serve as an example of resident utilization of POCUS devices: cardiac imaging of heart failure secondary to chronic hypertension (**Figure A**), abdominal imaging of large volume ascites in alcoholic cirrhosis (**Figure B**), retroperitoneal ultrasound of hydronephrosis in a patient with acute renal failure (**Figure C**), and vascular imaging revealing thrombus in proximal brachial vein of right upper arm using biplane imaging (simultaneous longitudinal and transverse views) (**Figure D**).