

## Chapter 1: Introduction

### WHY SHOULD I BUY THIS BOOK?

Point-of-care ultrasound (POCUS) has been used clinically since the 1980s. Improved machine image quality, portability, lower cost, and increased evidence for the diagnostic utility of point-of-care ultrasound has moved the probe firmly into the hand of the bedside practitioner. In the time-pressured setting of the emergency department (ED), clinicians have discovered new uses and created innovative workflows to integrate bedside ultrasound into clinical decision making. Critical care and other fields have followed suit, and burgeoning activity within general internal medicine is creating a niche for this imaging method. We clearly believe that point-of-care ultrasound benefits patients and physicians by improving diagnostic accuracy while bringing the physician back to the bedside and protecting patients from ionizing radiation. After your first time finding the unexpected cardiac tamponade in a patient with undifferentiated shock or getting a peripheral IV in the otherwise “impossible” patient, we think you will see the value in point-of-care ultrasound, as well.

New users of ultrasound are tempted to immediately integrate images into their clinical decision making. In medicine, however, bad information is worse than no information, and our conceptual framework emphasizes the following skills that need to be acquired by new users: 1) know the indications for a particular point-of-care ultrasound examination. 2) know how to acquire the images needed for high-fidelity. 3) know how to interpret the information acquired, 4) know how to clinically integrate the findings.

Our experience running an emergency medicine ultrasound fellowship since 2004 and creating the first combined emergency medicine/internal medicine (EM/IM) ultrasound fellowship in 2016, drove us to write this book. Our team includes senior EM doctors, IM doctors, and sonologist educators with more than 50 cumulative years of experience using and teaching ultrasound. Although numerous high-quality textbooks on point-of-care ultrasound have been written by luminaries in the field, it is impractical to bring a large text to the patient's bedside. And while there are several app- and Web-based resources, there is nothing like paper in hand—paper never runs out of battery or drops the Internet connection. We realize that trainees often need just a small nudge at the point of care: a reminder of what images to acquire and how to get them, or a quick glance at a pathologic image in comparison with a normal one. This book fills that need, providing those point-of-care tips for when a learner can't have an expert at their shoulder. It doesn't replace the comprehensive ultrasound text, but for the learner at all levels, this pocket guide will alleviate the anxiety of scanning while preventing some of the more common pitfalls.

### HOW TO USE THIS BOOK “... *but my pockets are already full!*”

Each chapter in this book is divided into four sections: Key Images, Acquisition Tips, Interpretation and Pitfalls, and Examples of Pathology. They are conveniently located on cards that can be popped out and brought with you to the bedside as a reference. Take notes on the cards! Check off the scans you've done! If your favorite scan isn't included, fear not: We are planning to release multiple click-in modules for different scans and different specialties. Many of the images in the book are actually stills from video files that are available as a part of the purchase at [www.accessmedicine.com/POCUS](http://www.accessmedicine.com/POCUS). We hope that this book will allow you to feel confident as you learn ultrasound at the same time as ensuring that your patients are receiving the best possible care.

### GENERAL ULTRASOUND POINTS

#### Indications

Point-of-care ultrasound is indicated for:

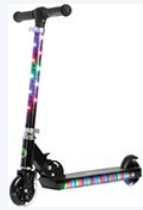
- Performing most bedside procedures for which a needle or device would otherwise be placed using landmarks and physical exam (e.g., thoracentesis, paracentesis, central line)
- Time-sensitive conditions (e.g., cardiac tamponade, pneumothorax)
- Diagnostic uncertainty (e.g., urinary retention, questionable pleural effusion on chest x-ray)
- To narrow an otherwise broad differential diagnosis (e.g., new chest pain, dyspnea, shock)
- To assess the effectiveness of an intervention (e.g., reassessment of the Inferior Vena Cava (IVC) after a fluid bolus, B-line assessment of the lungs after diuretics)

As with any test in medicine, the diagnostic performance of POCUS is dependent on the specific question being proposed. To use POCUS effectively and safely, the clinician needs some familiarity with the indications for an exam and the expected sensitivity and specificity of the result. For questions such as: Is there a pneumothorax? Is there a pericardial effusion? Is there pulmonary edema? POCUS has been shown to be better than chest radiography or physical exam alone. That being said, an ultrasound machine doesn't replace your brain. Ultrasound findings should always be integrated with the patient's entire clinical picture.

#### Ultrasound Machines—Choose Your Vehicle

There are an ever-increasing selection of machines to choose from, ranging from sleek handheld devices that plug into a smartphone up through massive carts that seem like they should require a forklift license to maneuver.

Small, but limited



Jack of all trades



The whole cabinet



Different types of machines are better for different settings. The resources and needs of your healthcare environment, including space, budget, availability of traditional imaging specialists, local patterns of disease will likely dictate your choice. Ergonomics may be paramount when a machine is going to be used for procedural guidance. A new generation of truly hand-held devices is likely to create an enormous increase in the number of providers with access to ultrasound, at the same time as creating new challenges for data management and communication.

Machine maintenance is important. The cords represent a common fragile point on the machine and the magic of piezoelectric crystals does not come cheaply, so dropped probes can be a source of both tears and financial hardship. Check the manufacturer's recommendations and your particular institution's infection-control recommendations for cleaning the machine. Some cleaners degrade the surface of the probe or can damage the console itself.

## Tips for Every Scan

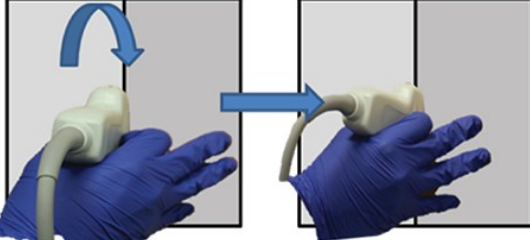
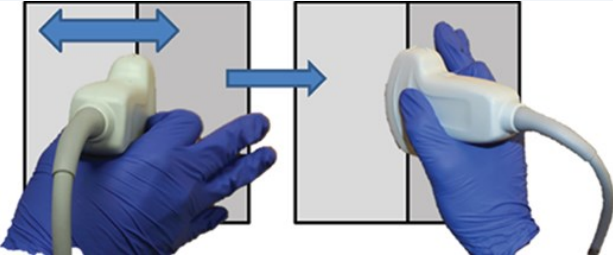
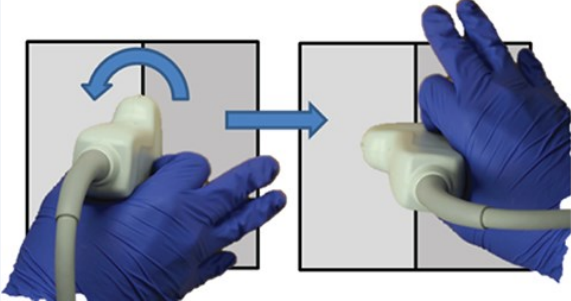
Every time a scanner prepares to do a scan, there's a checklist that should be applied:

1. Room setup: Make sure that the lights are dim, the machine has enough power, and you're considering the ergonomics of your exam. Machine and patient positioning for procedures is often different from that of diagnostic exams.
2. The Ps: patient, probe, preset: Enter the patient information so that your scans can be saved. Choose the right probe for the exam, and choose the right exam preset on the machine. Presets are like a cheat sheet to jump to the optimal settings for the average patient undergoing the exam.
3. Image optimization: That being said, we are rarely scanning the average patient, so adjust your image for every scan with the key factors (addressed in more detail in the physics chapter): frequency, depth, gain, focus, and dynamic range.

Traditionally scanners work from the right side of the bed with the probe in the right hand. Make sure you know which side of the probe is which. We prefer the “left is left” method described in the physics and knobology chapter to the “tap one side of the probe” method, but everyone can form their own patterns. Make sure you are following the orientation conventions for your scan. In the ED, that means the indicator dot is always on the left side of the screen, but for cardiac exams this book will follow the cardiology convention of having the dot on the right side of the screen.

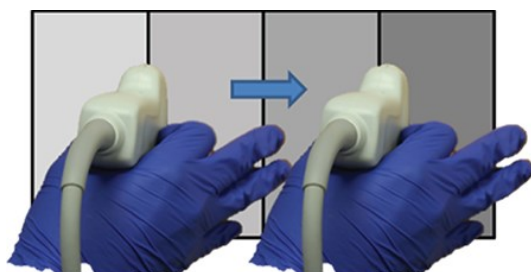
## Learning the Language

There are a number of ways to describe the movement of the ultrasound probe. Throughout this book we will use the following conventions:

<b>Rocking or "heel-toe"</b>	Tilt the probe along the axis of the indicator	
<b>Fanning or "sweeping"</b>	Tilt the probe perpendicular to the axis of the indicator	
<b>Rotating or "twisting"</b>	Rotate the probe about the axis of the cord without tilting	

## Sliding

Move the probe along the skin without changing angles



Video 01-01: Cardinal Movements

This video demonstrates the cardinal movements. First the probe "Slides" toward the camera, then away. After this, the probe "Rotates" 90 degrees counter-clockwise, then "Fan" back and forth. The probe is then rotated back to the original position, fans through structures once more, before "Rocking" toward and then away from the indicator dot.

[Play Video](#)

When adjusting your images, try to only do one of the four cardinal motions at a time. With expertise you will gradually build a model in your head of the relevant anatomy, which will allow you to more quickly go from probe placement to perfect image.

### Next Steps

One easy way to distinguish someone who is serious about learning ultrasound is whether they save and review their images. We strongly recommend developing or purchasing a system of image archiving and quality assurance, but at the very minimum a learner should be creating and reviewing their personal portfolio. After the tips in this book become internalized into your practice, go to the next steps. Find a more comprehensive book and review advanced imaging techniques. Visit an ultrasound conference and hear about what's coming down the pipe. Think about the next innovative technique and do a trial.

### Ultrasound: Past, Present, and Future

Machines are continually getting more portable and more affordable. We believe that we are rapidly approaching the point where an ultrasound will be viewed as akin to the stethoscope for all clinicians. For people who think that the challenges of becoming proficient with this tool are overwhelming, remember the reception Laennec received when he first introduced the stethoscope: "Notwithstanding its value, that it will ever come into general use is extremely doubtful, because its beneficial application requires much time, and gives a good deal of trouble both to the patient and the practitioner"—John Forbes, 1829.

Ultrasound is uniquely versatile, inexpensive, robust, and portable. These qualities make it the natural choice in resource-poor settings including the international space station, the permanent settlement in Antarctica, combat settings, and the developing world. Even in well-resourced settings, the needs at the bedside of every sick or unstable patient almost always outstrip the available resources. Whether you just graduated from Medical School or are close to retirement, it is never too late to learn the key aspects of a skill that will benefit your patients and increase your clinical self esteem and promote professional satisfaction. No one is an expert in every application of POCUS, so start by learning what will be most useful in your practice. This imaging modality is growing, and we hope that this book will make a skill set that may seem daunting more attainable. Scanning, like success, begets itself, and the only way to learn is to get started with the basics.

