

Bringing Ultrasound to the Family Medicine Cabinet

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Interviewee: Dr. Laurie Malia

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The thermometer was once a specialized instrument reserved for physician use. Today, it sits in nearly every home medicine cabinet.

The heart rate monitor was the rhythmic backdrop of patient rooms. Now, people check their pulses on their Apple watches.

From pregnancy tests to CPAP machines, blood pressure cuffs to glucose meters, technological devices that once necessitated medical-grade expertise have evolved into everyday items that people use to self-monitor their health. Dr. Laurie Malia, Medical Director of the Emergency Department at Morgan Stanley Children's Hospital, believes ultrasound could be next.

The technology behind ultrasound has centuries-old roots. After the discovery of echolocation in the 1700s and the development of sonar for submarine detection in the early 1900s, scientists began adapting sound waves for medicine. In 1942, Austrian neurologist Karl Theodore Dussik proposed using ultrasound to diagnose brain tumors. Within a decade, physicians were applying the technology to heart disease, and by 1958, after considerable debate over its safety, ultrasound was proposed as a tool for monitoring fetal development.¹

The skepticism was understandable. At the time, X-rays were the only way to see inside the body. With a blast of high frequency electromagnetic radiation, patients left these sessions with a striking image of their skeleton but also a dose of DNA damage. Ultrasound technology, however, is much safer than X-ray exposure. For pioneers like Dr. Ian Donald, who established the use of obstetric ultrasound, educating other physicians about the technology's safety and clinical value became a lifelong mission.¹

Ultrasound channels high frequency sound waves toward the body and measures the echoes that bounce back. Like echolocation, those echoes vary depending on the depth and density of the tissues they encounter. A handheld transducer both emits and receives the sound waves, while software converts the returning signals into a grayscale image. Fluid-filled structures appear black, bones appear white, and muscles and organs occupy shades of gray. Modern systems have even advanced further, offering colorized Doppler views of blood flow and even real-time 4D imaging.

The bulky, stationary ultrasound consoles of decades past have transformed into sleek, wheelable carts — and, more recently, into devices small enough to fit in a pocket. With little more than a handheld probe and a connected screen, ultrasound has been ushered out of the dark back rooms of radiology suites and directly to the bedside. This approach, known as Point-of-Care Ultrasound (POCUS), has transformed how physicians evaluate patients.

Within the last few decades, ultrasound has gone mainstream. In pregnancy, not only is it routine, but printed sonograms are expected and often treasured as keepsakes. When expectant parents excitedly share an ultrasound image, most people can recognize the outline of a fetus. Beyond that basic recognition, however, acquiring high-quality images and interpreting them accurately requires both an adept hand and trained eye.

Today, both tasks remain firmly in the hands and eyes of healthcare professionals. But as pocketable POCUS devices become increasingly accessible, Dr. Malia is asking whether patients—and particularly parents of pediatric patients—might eventually participate in the imaging process. Dr. Malia, herself, regularly uses POCUS in the Pediatric ED, and she is quick to recommend it.

At her practice, POCUS gives her immediate insight at the bedside. Curious parents often lean over to watch, eager to understand the shifting shades of gray. Interpreting those images, however, remains a bridge too far for most non-clinicians. Dr. Malia is exploring ways to close that gap for patients who cannot make it into the doctor's office.

Instead of asking parents to interpret scans, she wonders if parents might perform the scans themselves while clinicians analyze the resulting images remotely. Her team recently became the first to formally test that idea. Published in the *Journal of Ultrasound in Medicine* in April 2024, the pilot study examined whether parents could perform lung ultrasounds on their children at home after receiving only basic instruction. Among 18 participating families, the study found that at-home pediatric ultrasound was feasible.²

In considering the results of this study, it is worth noting that this study's funding was supplied by one of the primary handheld ultrasound machine companies, Butterfly Inc.

Parents successfully obtained acceptable quality lung images during more than half of the seven-day study period. Failed scans typically resulted from missing the intended anatomy, excessive motion from squirming children, or unsuccessful attempts to complete the examination. Maneuvering a probe takes patience and practice. Even a slight tilt of the transducer can dramatically alter the image. It is easy to imagine the added challenge of trying to perform a careful scan on a restless child.

“The biggest barrier was how long it took in getting the kid to stay still,” Dr. Malia said. “That also was a limiting factor in their image quality.”

The results of this study were far from perfect, revealing the expected challenges of placing a sophisticated medical device in inexperienced hands. Yet, they also raise an important question: could ultrasound someday become yet another medical technology that patients use routinely at home rather than exclusively in hospitals?

Adult medicine is already beginning to explore that possibility.

“There are a lot of initiatives in the adult world of hospital-at-home, which has not so much been transitioned to pediatrics,” Dr. Malia said.

Hospital-at-home programs deliver hospital-level care in patients' homes, and researchers are now investigating how handheld ultrasound might fit into that model. Dr. Malia's work extends that conversation into pediatrics—and goes a step further by asking how much of the imaging process families themselves might reliably perform.

She believes the first beneficiaries would likely be children with chronic illnesses rather than otherwise healthy patients, which the study pulled from. Consider a child living with pulmonary hypertension. Lung ultrasound already helps clinicians monitor disease progression and identify complications such as pulmonary edema (fluid in the lungs) or pleural effusions (fluid around the lungs). With appropriate training, parents could potentially perform scans at home whenever symptoms arise, allowing clinicians to review the images remotely and determine whether a hospital visit is truly necessary.

“Parents are looking for reassurance,” Dr. Malia said. “When they come to the hospital, they are always coming out of worry. If there would be a way to reassure themselves at home that something looks good or is reassuring, I think there would definitely be buy-in.”

Such an approach could spare families unnecessary trips to the emergency department while helping clinicians prioritize patients who truly need immediate care. And if an emergency room trip is necessary, their care may be streamlined upon arrival.

Significant obstacles remain before that vision becomes reality. Questions surrounding image quality, user training, cost, workflow integration, and liability all need answers. Some families may also feel more confident and thus comforted when imaging is performed by trained medical professionals rather than by themselves.

It is too early to claim that handheld ultrasound will revolutionize pediatric home care. But the idea is no longer inconceivable. It is now an active area of research.

The earliest ultrasound machines required patients to climb into large metal tanks filled with water while clinicians operated cumbersome equipment overhead.³ Compared with those machines, today’s handheld probes already represent a remarkable transformation. Is it so far-fetched then to, one day, find these devices tucked beside the thermometer in the family medicine cabinet?

References:

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Bolded citation was the primary focus of this paper