Handheld Ultrasounds: Pocket Sized, but Pocket Ready?

It is comforting and plausible that portable, handheld medical diagnostics improve health outcomes. After all, when a clinician wants to know left ventricular function—ordering the test, waiting for a technician to perform it, a cardiologist to read the study, and the computer system to upload results—all appear as needless delays. When clinical decisions depend on the results of ultrasound imaging, portability seems a virtue. Portability also means that we can screen for disease without loss to follow-up. Physicians have shown that portable ultrasounds can be used to screen for abdominal aortic aneurysms\(^1\) in patients who present to the emergency department with unrelated complaints.

And yet, the easier it is to ascertain diagnostic information, the greater the chance of incidental findings or over-diagnosis, identifying abnormalities that carry no clinical consequence. For instance, carrying a pocket ultrasound may lead zealous practitioners to look for thyroid nodules, pancreatic or ovarian masses, or carotid artery stenosis in asymptomatic patients—all of which are “D” recommendations of the US Preventive Services Task Force—meaning that harms outweigh benefits.

In recent years, the medical profession has been critical of the hasty adoption of new diagnostic technologies. Regarding screening for coronary artery disease with electron-beam computed tomography (EBCT), Chen and Krumholz write, “Evidence that EBCT is effective in reducing mortality or morbidity is arguably the most important barrier that this technology must clear before its routine use can be justified.”\(^2\) And regarding routine screening for genetic polymorphisms to inform antiplatelet treatment decision, Nissen writes, “no matter how promising, pharmacogenetic approaches to treatment must withstand the same scrutiny required of all therapeutic advances—careful evaluation through well designed randomized clinical trials.”\(^3\)

And yet, when it comes to technology that we keep in our pocket, we have not extended this standard. Distinguished physicians are already using and promoting these tools. In The New York Times, Abraham Verghese\(^4\) endorsed Vscan, a pocket ultrasound made by General Electric (Fairfield, Conn). Eric Topol, a long-time proponent of pocket technology, proclaimed the benefits of bedside ultrasonography in a Technology, Innovation, and Design (TED) talk in 2009.\(^5\) Many physicians have already purchased these tools, and the Vscan device has been called “a game changer.”\(^6\)

We sought to identify whether there is prospective evidence which shows that handheld or pocket ultrasounds improve meaningful (morbidity or mortality) outcomes in any setting. We performed a systematic review of publications reporting the diagnostic value or clinical outcomes benefit of bedside ultrasonography. Using search strategies including the following key words: bedside ultrasound, benefit, outcomes, hand-held ultrasound, and portable ultrasound, we performed Google Scholar and PubMed searches. We retrieved and reviewed abstracts of 50 articles, and read 25 in full.

Several publications suggest that handheld ultrasounds can improve diagnostic categorization. For instance, Martin et al\(^7\) showed that adding handheld ultrasound to the physical examination improved hospitalists’ assessment of left ventricular function, pericardial effusion, and cardiomegaly. Similarly, Kobal et al\(^8\) demonstrated that detection of valvular disease and left ventricular dysfunction by medical students using a hand-carried ultrasound after brief echocardiographic training was superior to experienced cardiologists performing a physical examination. Other groups have shown the diagnostic utility of the bedside abdominal ultrasound in the intensive care unit in detecting new pathological findings.\(^9\)

When it comes to performing procedures, the ultrasound has indeed been shown to improve clinical outcomes. For instance, Sibbitt et al\(^10\) note that ultrasound-guided corticosteroid injections of osteoarthritic knees reduced procedural pain, reduced pain scores, and improved therapeutic duration (among other positive outcomes). Miller et al\(^11\) demonstrated a benefit of using the ultrasound in the placement of central venous catheters. When compared with the traditional anatomical landmark technique, the ultrasound-guided technique was associated with both a decrease in number of central venous access attempts and time required to cannulate the vein, particularly in patients with difficult access.
Although portable ultrasounds can improve procedural outcomes, these data justify the device’s use only for these particular purposes (performing procedures), and not others. We find it unlikely that current users of the device deploy it so selectively, and the physicians who endorse the device are not so cautious in their enthusiasm. For diagnosis, the available evidence confirms that the handheld ultrasound can identify more anatomic pathology, but we have no evidence that any clinical benefit is garnered by the immediacy of this information. In short, our evidence base supports the device’s use only for specific tasks, but carrying the device inherently lends itself to indication drift.

While many are critical of our uncritical acceptance of new medical technologies without robust evidence, why have few challenged the growing use of pocket diagnostics? Is there something about owning and carrying a device that changes the standard against which it is judged? We think this is unlikely. Patients may not bear the costs of these diagnostics, but they fully bear the benefits and harms. Instead, our uncritical acceptance of bedside diagnostics is spurred by enthusiasm, not science.

We have confined our analysis to handheld ultrasonography, but our principles extend to all medical devices that interrogate patients, or utilize their data to alter clinical decisions. Handheld ultrasounds are already being used in clinical practice, and have been most studied, but other technologies such as home ambulatory wireless cardiac monitoring devices are in development. We contend that physicians who purchase or recommend these technologies use them only for evidence-based indications, or under the auspices of adequately powered clinical trials.

While improving the rate at which one finds abnormalities seems like it should benefit patients, it is unclear if this truly is the case. Coronary artery CT scans for patients who present to the emergency department with chest pain and normal cardiac biomarkers have been shown to identify more coronary artery disease, but they have been faulted for failing to show that this information can meaningfully improve health outcomes. In today’s world, no one doubts that more noninvasive diagnostic testing can identify more disease, and proving this is no great feat. Instead, we must ask whether this information improves our patient’s health, or instead, whether it merely prompts further, invasive testing, with harms outweighing benefits.

References
2. Chen J, Krumholz HM. How useful is computed tomography for screening for coronary artery disease? Screening for coronary artery disease with electron-beam computed tomography is not useful. Circulation. 2006;113:125-146; discussion 146.