

# Revolutionizing the doctor's black bag

## A step to revitalizing primary care in medicine

David B. Hellmann, M.D., Quinn Whiting-O'Keefe, M.D., Roy C. Ziegelstein, M.D., L. David Martin, M.D., and Edward Shapiro, M.D.

Dr. Hellmann (AΩA, Johns Hopkins University, 1998) is the Mary Betty Stevens Professor of Medicine and chairman of the Department of Medicine at Johns Hopkins Bayview Medical Center. He is a member of the editorial board of *The Pharos*, and a previous contributor to the journal. Dr. Whiting-O'Keefe (AΩA, University of Utah, 1974) was associate adjunct professor of Medicine and Medical Information Science at the University of California, San Francisco, and senior vice president of engineering at Bell Atlantic Healthcare Systems. He is retired and lives in New Zealand. Dr. Ziegelstein (AΩA, Boston University, 1986) is associate professor of Medicine at Johns Hopkins University School of Medicine. Dr. Martin (AΩA, Bowman Gray University, 2000) is assistant chief of service at Johns Hopkins Bayview Medicine Residency Program and an instructor at Johns Hopkins University School of Medicine. Dr. Shapiro is professor of Medicine at Johns Hopkins University School of Medicine.

On Friday, September 1, 1939, Nazi Germany invaded Poland. According to historian William Manchester, "the Poles were brave beyond belief."<sup>1</sup> Unfortunately, they also were wedded to tradition beyond comprehension. In the words of military historian and author Sir Basil Henry Liddell Hart, the Polish army "still pinned their trust to the value of a large mass of horse cavalry, and cherished a pathetic belief in the possibility of carrying out cavalry charges. In that respect . . . their ideas were eighty years out of date, since the futility of cavalry charges [against modern weapons] had been shown as far back as the American Civil War."<sup>1,2</sup> One million gallant Poles charged on horseback with their sabers gleaming, and tens of thousands were massacred by Germans armed with Panzers, machine guns, and Stuka dive bombers.

This story illustrates how dangerous it is, in a technologically advancing world, to cling to outdated methods and tools. The Polish army's failure to adopt new technology led it to fight a twentieth-century opponent with nineteenth-century weapons and tactics. The result was the loss of many brave men, and of the war.

The diagnostic tools available to primary care physicians to support the bedside examination—the contents of the "black bag"—are today as out of date as the cavalry charge was in Poland in 1939. Although this analogy may seem anomalous to some, in our view the practice of medicine can reasonably be considered a war, one that pits patients and doctors, with all the skills and tools they can muster, against human disease. The stakes are equally high, and the failure to adopt new technologies could be as consequential for patients and primary care medicine as that failure was for Poland and the Polish army. It is time to introduce modern tools into the black bag; in the process, what a physician can accomplish at the bedside can be transformed.

### The bedside examination today

The bedside examination supplements the medical history, providing reliable information about a patient's health and disease status, and giving the physician enough personal and physical contact with the patient to help build trust and a positive therapeutic relationship. Unfortunately, many of the observations made at the bedside using traditional tools are inaccurate or imprecise, and either require exceptional skill to do well, or are based on unverified assertions about specific findings and their alleged clinical implications.<sup>3,4</sup> Faith T. Fitzgerald's 1990 review of physical diagnosis identified some aspects of health and disease, such as nutritional status, hemoglobin level, and hepatomegaly, that can be assessed accurately by physical examination.<sup>3</sup> However, many parts of the physical examination are inaccurate or not reproducible. In one example, cardiologists could accurately assess ejection fraction semiquantitatively (normal to markedly decreased) only 61 percent of the time. In another study, physicians accurately detected splenomegaly only 28 percent of the time.<sup>3</sup> More recently, Steven McGee's 910-page book, *Evidence-Based Physical Diagnosis*, comprehensively summarizes the sensitivity, specificity, and likelihood ratios of the components of the clinical examination so studied.<sup>4</sup>



There are reasons for the inaccuracy and lack of precision of the bedside examination. Many studies indicate that, in the United States, physical examination skills are not taught well. The wide ranges for sensitivity and specificity in the table below document how variably some components of the physical exam are assessed.<sup>4</sup> Only 27 percent of all internal medicine programs and only 37 percent of cardiology fellowship programs offer formal courses in auscultation of the heart.<sup>5</sup> Some traditional physical signs are neither sensitive nor specific:<sup>4</sup> Phalen's sign, for example, appears to have little or no value in the diagnosis of carpal tunnel syndrome.<sup>6</sup> As well, knowledge on which the physical examination is based is sometimes faulty, grounded on opinion rather than on scientific data.<sup>4</sup> Fortunately, some of these problems are now being corrected by the movement to evidence-based medicine.<sup>4,7</sup>

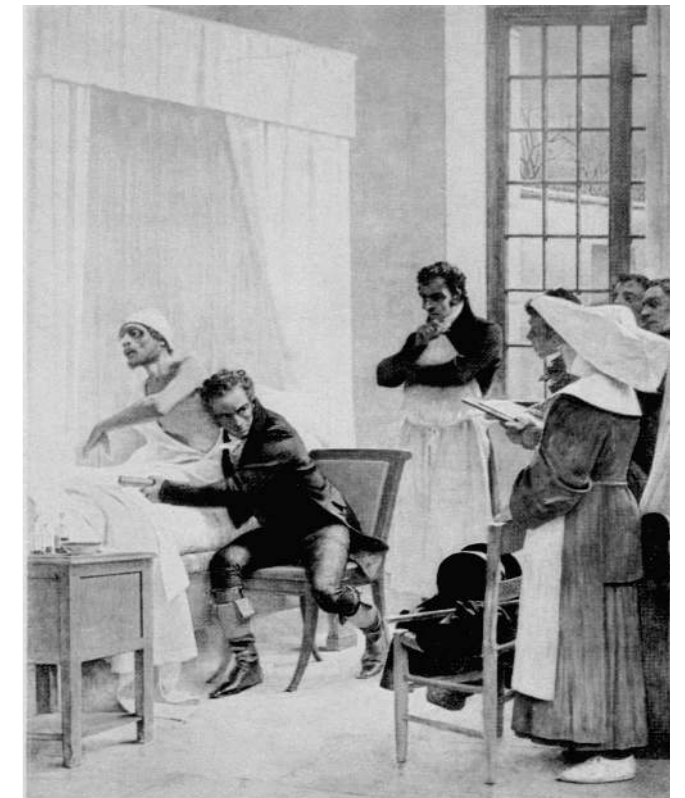
Accuracy of Some Components of the Physical Examination				
	Sensitivity, %	Specificity, %	Likelihood Ratio	
			Positive, sensitivity/1-specificity	Negative, 1-sensitivity/specificity
Detecting an enlarged liver	50-71	56-77	1.7	0.5
Detecting an enlarged spleen	18-69	89-99	9.6	0.6
Detecting mild tricuspid regurgitation or worse	23	98	14.6	0.8
Loud P2 detecting pulmonary hypertension	48.96	19-46	NS	NS
Early diastolic murmur for detecting mild aortic regurgitation or worse	54-87	75-98	9.9	0.3
Conjunctival rim pallor for detecting anemia	10	99	16.7	-

Data taken from reference 4.

Nonetheless, many parts of the physical examination, such as the analysis of cardiac murmurs, require much instruction and experience to master.<sup>3</sup> This means that many clinicians will never acquire the skill level of an expert, and will therefore never obtain the depth of information of skilled experts. And some important areas of the physical examination appear to elude accurate assessment, even in the hands of experienced and skilled practitioners. The hemodynamics of the heart, especially the right heart, is one example.<sup>8</sup> Others include the detection of a displaced trachea and of tactile fremitus, which have kappa statistics of 0.01. (A value of 1.0 indicates perfect agreement and 0 indicates no agreement.)<sup>4</sup>

Many of the deficiencies of the bedside examination arise from the use of instruments that have not changed in over a century: traditional tools cannot take advantage of modern technology. The stethoscope was invented by Laënnec in 1819,

and the ophthalmoscope by von Helmholtz in 1851.<sup>9</sup> The latest instrument added to the black bag of most primary care physicians was the sphygmomanometer, invented in the late nineteenth century, and first introduced in America by Harvey Cushing in 1901.<sup>10</sup> Imagine our society if surgical procedures, accounting devices, and modes of transportation and communication were entirely dependent on inventions from over 100 years ago! No lasers, plastics, computers, mobile telephones, printers, all but a few drugs, microprocessors, anesthesia as we know it, X-ray imaging (much less magnetic resonance, computerized axial tomography, or sonography), or most laboratory tests! But primary care physicians today conduct their bedside examinations armed only with nineteenth century tools.



Laënnec at the Necker Hospital, auscultating a tuberculosis patient in front of his students. From a mural painting by Theobald Chartran, 1816. Courtesy of the National Library of Medicine.



### What can be done to improve accuracy in physical exams?

Some of the causes of inaccuracy and insensitivity of parts of the physical exam are currently inescapable. Some, however, are not. The use of modern tools could make the clinical

examination far less dependent on extraordinary observer skill and experience. Bedside examinations could be extended to include observations that formerly required specialized laboratories. Today's advances in micro-electronics and miniaturization make possible portable diagnostic tools that go far beyond the stethoscope and blood pressure cuff, that might dramatically increase the information flow to the clinician at the bedside. Among the devices now available and under continuing development are portable ultrasound devices, oximeters, panoptic ophthalmoscopes, and digital cameras. The rapid pace of innovation raises the not-too-distant prospect of being able to perform at the bedside diagnostic tests based on gene chips or proteomics. Ultimately, decisions about adding new technologies to the conventional physical examination must be guided by judgments about the effects new technologies might have on the accuracy, financial costs, and convenience of the bedside examination, and on the therapeutic relationship with patients.

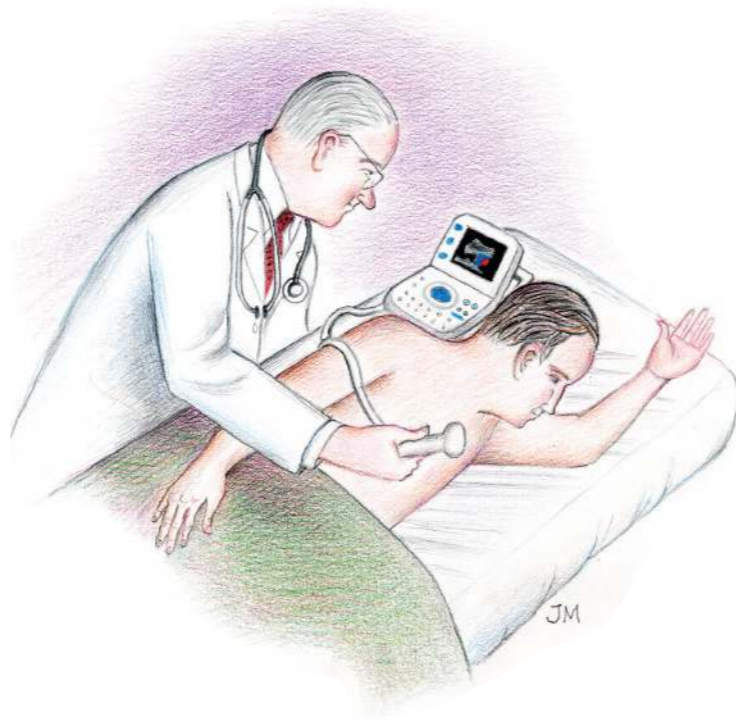


### Handheld ultrasound—a tool for the black bag?

Because of its availability and its many potential uses, we believe that the portable ultrasound device should be the first addition to the new and enhanced black bag. Several companies have succeeded in miniaturizing ultrasound devices to about the size of a small textbook weighing about 1,400 grams and costing around \$15,000.

Bedside ultrasound and Doppler technology would allow primary care physicians to accurately assess disease processes that currently are evaluated only inaccurately or imprecisely by the traditional physical examination.<sup>3</sup> Primary care physicians would, for example, be able to detect pericardial fluid and to assess accurately the size of the left ventricle, the ejection fraction, and the functioning of the mitral and aortic valves. Other observations not easily or effectively made by traditional physical examination could be better determined using handheld ultrasound devices. These include liver and spleen size, ascites, abdominal aneurysm, bladder obstruction, the presence of masses, detection of cysts of many types, and the location of central veins for catheter insertion.

The utility of hand-carried ultrasound units in the diagnosis of cardiac disease has now been evaluated in a number of studies. Surprisingly, the image quality of these units is similar to that of their top-of-the-line cousins, with a sensitivity of 97 percent and a specificity of 99 percent for detection of moderate-to-severe cardiac pathology.<sup>11,12</sup> Cardiologists using handheld ultrasound devices in inpatient and outpatient settings commonly make important, unanticipated findings,<sup>13</sup> while missed findings are reduced by 51 percent.<sup>14</sup> Handheld ultrasound devices improve the accuracy of diagnosis and lead



to changes in therapy in patients hospitalized for acute cardiac care.<sup>15</sup> In a group of 13 medical residents using the device, 10 improved their physical exam skills as a result of the feedback provided by the devices.<sup>16</sup> Another study in academic emergency departments demonstrated that 95 percent of emergency departments already use portable ultrasound.<sup>17</sup>

Obviously, adequate training is important, both in the technical acquisition of images and their interpretation.<sup>13,14,18</sup> The American Society of Echocardiography recommends level I training for the responsible performance of the focused echocardiographic examination,<sup>19</sup> but the level of training required for primary care physicians to obtain general information—to determine whether a pericardial effusion is present or whether left ventricular function is normal or reduced, and, importantly, to determine when to order a specialist examination—is unknown. The utility of examinations may also depend on the patient population; concerns have been raised about the accuracy of the technology's use with critically ill patients.<sup>20</sup>

Studies are needed on the use of portable ultrasound for primary care physicians: How valuable is ultrasound to physical examinations in primary care practice? Will its use enhance physical examination skills by providing an immediate visual reinforcement to the auscultated murmur or to the palpated pulsatile abdominal mass? Does ultrasound improve diagnosis or therapy, and if so, how? Will routine use of portable ultrasound during the bedside examination increase the net information flow to the decision making clinician?



### Will another "machine" harm physician-patient interactions?

Before portable ultrasound devices can be recommended for general use by primary care physicians at the bedside, we need to know how their use will affect the physician-patient

relationship. Medicine is both an art and a science, and a foundation of the art, and to some degree also the science, is the relationship between the patient and doctor. The use of an electromechanical device in the physical examination might further degrade what many people perceive as an already compromised relationship. We believe physicians can interview and interact with patients at the bedside and still be assisted by modern tools that make the interaction more effective. Many patients are unaware how much close physical contact is normal during cardiac ultrasound. Examiners sit on or near the bed with an arm controlling the probe extended over the patient. Conversation is possible, unlike what is appropriate during most parts of the physical exam, and the experience is surprisingly intimate and not at all unpleasant.



### Generating a change in generalist-to-cardiologist referrals . . . and in reimbursement policies

Are bedside ultrasound examinations by primary care physicians as good as those specialists perform? The studies with cardiologists cited above show that the technical quality of the devices is not the primary issue, but that the skill and training of the operator determines the quality of the data. Thus, primary care physicians are unlikely to do as well as specialists. Most relevant, however, is which system will more frequently return essential information to the process of clinical decision making. It is likely that fewer specialist sonograms will be ordered if primary care physicians perform their own sonograms. More sonograms will be made by generalists, with greater efficiency and timeliness, but whether the increased information flow will balance their higher rate of errors is not known. That situation, however, is not very different from that routinely faced by primary care physicians today in deciding when the superior experience and skills of a specialist are needed to supplement their own knowledge and skills, and whether they should therefore order a consultation.

Because the prices of electronic devices such as calculators and computers have declined sharply over time, it is reasonable to expect that the current cost of handheld ultrasound devices, now approximately \$15,000, will fall. Expanding the market for these devices to nonspecialists, and reducing the available features to only those needed by general physicians may also result in substantial cost reductions. It thus seems possible that the price of basic models could approach that of personal computers.

Given the rate at which portable ultrasound devices are already finding their way to the bedside, it seems certain that such devices will soon be in routine use there. But will primary care physicians use them, and will they put them to work as needed, as they do now with the ophthalmoscope, stethoscope,

reflex hammer, tuning fork, and all the other tools in the traditional black bag? It is substantially a question of reimbursement. On the one hand, we might have a single billable entity of "physical examination with ultrasound," in which the clinician uses the tool as needed during his examination, and on the other hand, we might have some physicians (probably specialists) becoming qualified in various uses of the portable ultrasound and charging separately for each examination done.

The battle lines are now being drawn, although not necessarily along rational lines. Insurance companies appear determined to resist reimbursement of any kind. National Heritage Insurance Company, for example, the Medicare carrier for California and several other states, recently denied payment for cardiac studies using handheld ultrasound devices.<sup>21</sup> Other insurance carriers such as Cigna<sup>22</sup> also decided to deny payment for handheld ultrasound studies. These carriers base their decisions on the concept that studies using handheld ultrasound are part of the physical examination of the vascular system, and are therefore not separately reimbursable.

Because of the broad utility of ultrasound, we believe it should ultimately become an integral part of the bedside examination. Reasonable compensation for the additional cost of the device, necessary training, and the time required to perform the study seem appropriate. In any case, the current reluctance of the payers to reimburse should not be allowed to determine the fate of an innovation that could turn out to effect a substantial increase in both the quality and efficiency of medical care.



### Technology: an aid to luring students to primary care

A reconstituted black bag could improve the quality and efficiency of patient care, although this contention needs proof. And there are other reasons for redesigning the black bag. Interest in primary care internal medicine and family practice has steadily eroded for years.<sup>23</sup> In 2004, only 188 graduating U.S. medical students sought training in primary care internal medicine programs.<sup>24</sup> New tools to improve the accuracy and utility of bedside diagnosis could restore some of the luster and status to primary care physicians, and increase the appeal of the profession to medical students and residents. A recent study showed that medical students choosing surgery, emergency medicine, and obstetrics and gynecology are more likely to be "novelty seekers" than those choosing other specialties. Adding new technologies to primary care practice may increase the perception that this area of medicine is vibrant, evolving, and "cutting edge," and may thus attract those who are currently drawn to other specialties.<sup>25</sup> Improving the capacity to make discoveries at the bedside could help reverse the "eureka penia" that now seems to plague residency training programs.<sup>26</sup>

It now seems certain that portable electronic diagnostic devices such as handheld ultrasound devices will be widely used at the bedside. The question is whether they will be an integral part of the primary care physician's diagnostic toolkit—an enhanced black bag—or whether they will be just another billable service in the hands of specialists.

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Address correspondence to:

David B. Hellmann, M.D.  
Johns Hopkins Bayview Medical Center  
4940 Eastern Avenue  
B1-North, Room 109  
Baltimore, Maryland 21224  
E-mail: hellmann@jhmi.edu