Blaufuss Virtual Patient Examinations (VPEs) for Cardiac Examination

BACKGROUND

Competency with a stethoscope is a prerequisite for every physician, nurse and other allied health professional. Yet this basic skill is in decline at all levels of medical training. The depopulation of teaching hospitals of “good teaching cases,” and the reduced instruction time by attending physicians have contributed to the problem. What is worse, recent test data indicate that full-time faculty are no better at detecting heart sounds than their students (Fig. 1).

Figure 1: We developed an interactive multimedia CE Test that measured the auscultation skills of 854 medical trainees and graduate physicians in academic and private practice. Mean test scores were not significantly different among medical students, residents, or the faculty who teach them.

PP = private practice
VCF = volunteer clinical faculty
FAC = full-time university faculty

Columns represent mean scores, error bars 95% confidence intervals. Cardiology fellows tested significantly better than all other groups (P<0.01). Only first- and second-year students tested significantly worse than all other groups (P<0.01).
SOFTWARE TRAINING WITH SUPERIOR BENEFITS AND PROVEN OUTCOMES

While many heart sounds teaching products and simulators are available, only Blaufuss programs have been demonstrated to improve heart sounds proficiency in controlled trials (see Figs. 2-4). Reasons to choose Blaufuss are numerous.

**Expert:** Represents over 40 years experience in teaching heart sounds, and over 10 years experience in producing medical multimedia software.

**Multimedia:** Provides at least two (and often all three) sensory modalities of cardiac examination simultaneously.
- video of neck, precordium, and extremities
- audio recorded through the stethoscope
- palpable carotid pulse

**Multi-platform:** Has web-based, PC-based, and handheld versions.

**Distributed:** Runs multiple copies of the programs, obviating the need for dedicated rooms, hardware, and specially trained staff.

**Scalable:** Can be used for large or small groups, or self-assessment programs.

**Objective:** Assesses cardiac examination skills reliably with a test refined over 4 years at 16 institutions over 850 subjects.

**Reproducible:** Ensures that each student, resident, and fellow is exposed to a spectrum of disease with representative findings.

**Realistic:** Uses audiovisual recordings of real patients, with case-matched ECG, CXR, echo, and cath lab data for rigorous training and assessment. Blaufuss never uses simulated heart sounds.

**Proven:** Shows significant improvement in cardiac examination proficiency from controlled trials of medical students, residents, and cardiology fellows.

**Economical:** Total cost of ownership is a fraction of other systems.
- relies on the existing computer infrastructure
- provides hardware maintenance and repair free of charge for two years
- maximizes the number of simultaneous users with distributed programs, which in turn eases the impact on scheduling, since small groups do not have to be rotated through a single station
- benefits medical students, residents, and fellows with programs for several skill levels
Third-year medical students who received 12 hours of instruction with Blaufuss software showed significant improvement in their test scores, from mean of 58 to 74 (P=0.00005). After training, these MS3 students tested at the level of first-year cardiology fellows. Controls who received no special training during their medicine clerkships did not improve significantly. A subset of the intervention group was tested more than a year later with no additional intervention: their scores improved further, indicating that they had not only retained what they had learned, but were building upon it.

Interns in family and internal medicine during their CCU rotation spent an average of 5 hours of guided self-study using CE Web tutorials on the Blaufuss website (www.blaufuss.org). With limited faculty involvement, mean test scores improved from 54 to 69 (P=0.006). For the control group, mean scores improved only 2 points (P=0.59).

Blaufuss software is fully integrated into the curriculum of the cardiology fellowship program at Harbor-UCLA Medical Center. To measure baseline proficiency, the entering fellows are tested in July, and their mean test scores are indistinguishable from those of first-year fellows from other programs. But by the second and third years, software training improves their scores significantly over other fellows. In fact, by the third year it appears that cardiac auscultation proficiency actually deteriorates in other programs.
PRODUCT SUMMARIES

We currently offer nine programs on cardiac examination.

1. **CE Tutorial**

This introductory program provides training on how to establish bedside findings through inspection, palpation and auscultation. It is appropriate for any level of training. Actual patient videos with simultaneous heart sound recordings provide highly realistic training, with examples of normal and abnormal findings. Computer animations illustrate anatomy, hemodynamics, phonocardiogram, as well as the motion of the cardiac chambers and valves. The program includes three modules: cardiac examination, peripheral vascular examination, and blood pressure measurement. Ideal for instructor-led tutorial or self-guided study.

2. **The Physiological Origins of Heart Sounds & Murmurs**

The first and only comprehensive multimedia reference for cardiac auscultation. This program contains 135 examples that integrate heart sounds and murmurs with animations and dynamic laboratory data, including ECG, phonocardiogram, pulse, intracardiac pressures, echocardiogram, and cineangiography. Topics include normal, valvar lesions, pericardial disease, congenital heart disease, cardiomyopathies, and myxoma. New and improved for Windows 2000 and XP.

3. **CE Interactive**

Guided tutorials on examining ten patient “unknowns.” The student or trainee receives immediate feedback when answering questions that lead toward establishing the physical findings and differential diagnosis. Each patient presentation contains pertinent history, video of neck and precordium with simultaneous heart sounds recorded over multiple listening locations. Includes case-matched ECG, CXR, and echocardiogram. Discussion follows, explaining the results of the laboratory studies, including cath lab hemodynamics where appropriate, and their correlation to the physical findings. Ideal for instructor-led tutorial or self-guided study.
4. CE Cases 1-5

Full-featured case-matched patient presentations of the most common valvar lesions of the left heart. These virtual patient examinations (VPEs) are designed to run with the desktop Pulsator™, allowing simultaneous inspection of the patient, palpation of the pulse, and auscultation of the heart findings. Each case includes chief complaint, patient’s history, recordings of patient’s pulses as a timing reference, actual heart sounds and/or murmurs and diagnostic studies (CXR, echocardiogram, cineangiogram). Stunning high-resolution digital patient videos with simultaneous heart sound recordings over several listening areas. Case-matched 12-lead ECG, CXR, echocardiogram, as well as cineangiogram. Ideal for classroom presentation, morning report, or conferences. The cases can also be used as an assessment tool by the instructor.

5. CE Web

Web-based tutorial that demonstrates and explains the findings for the four most common lesions of the left heart: aortic regurgitation, aortic stenosis, mitral regurgitation, and mitral stenosis. Actual heart sounds, patient video, hemodynamics, and computer animations are optimized for low-bandwidth delivery. Morphing from normal to abnormal states of carotid pulsations and hemodynamics, as well as adding and removing sound components (e.g., extra sounds and murmurs) enhance recognition of physical findings. Ideal for instructor-led tutorial or self-guided study.

8. CE Quiz

Self-guided, highly interactive drill on nine patient recordings with animated carotid pulse. As you identify which sounds and murmurs are present, your answer forms an interactive phonocardiogram, allowing easy comparison with the patient’s correct phonocardiogram. Identification of the auscultatory findings is emphasized over physical diagnosis. The quiz can be used with or without the Pulsator. A PDA version is available that will play with specific handhelds.

9. CE Test

Formal assessment tool of cardiac auscultation proficiency. This 50-question, interactive multimedia program uses audiovisual recordings of actual patients, allowing observation of pulses and respiration while listening over multiple areas. It has been used in several controlled intervention trials to measure improvement in cardiac examination. Ideal for measuring pre- and post-training proficiency.