

A Cardiology Patient Simulator for Continuing Education of Family Physicians

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“Harvey,” the cardiology patient simulator (CPS), is the result of a new type of simulation technology that allows for repetitive practice of bedside cardiology skills and provides feedback to the learner. “Harvey” is able to realistically simulate an essentially unlimited number of both common and rare cardiac diseases. This report describes the use of the CPS in continuing medical education programs conducted for members of the American Academy of Family Physicians.

Cardiovascular disorders constitute a significant percentage of the practice of family physicians. The CPS teaching system has great potential for helping them keep their cardiovascular diagnostic skills current and for promoting better understanding of recent advances in the diagnosis and treatment of heart disease. The participants in this study were nearly unanimous in their feeling that the CPS accurately simulates cardiology bedside findings and is a valuable teaching tool with which they would like to again be taught in the future.

The success of the initial evaluation of patients with suspected cardiovascular disease requires both an accurate and skillfully obtained medical history and physical examination based on a systematic approach to cardiovascular clinical problem solving. The acquisition of both these skills, in

particular the bedside skills necessary for accurate diagnosis, is facilitated by repetitive practice in a setting where feedback on the accuracy of one's observations is possible.

“Harvey,”* the cardiology patient simulator (CPS) (Figure 1), is the result of a new type of simulation technology that allows for repetitive practice of bedside skills and provides feedback to the learner. The CPS realistically represents an essentially unlimited number of both common and rare cardiac diseases.¹⁻³ It is currently programmed to faithfully simulate the blood pressure, bilateral jugular venous and arterial pulsations,

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*The CPS is named after W. Proctor Harvey of Georgetown University.

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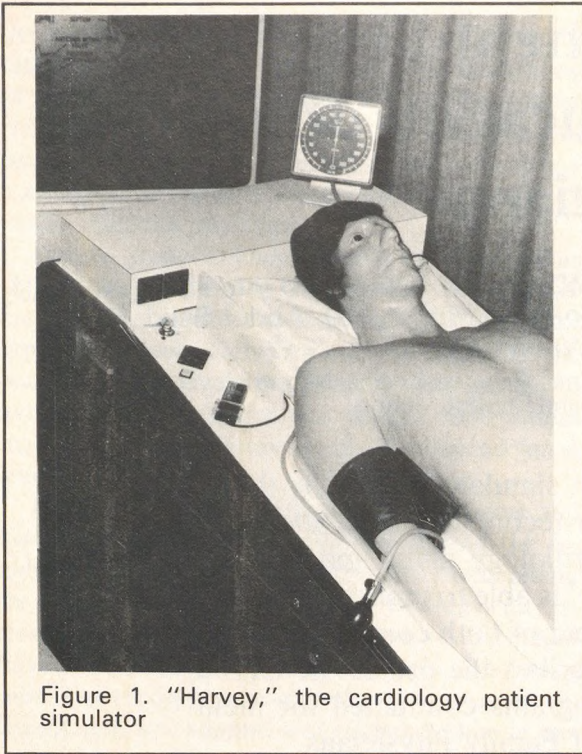


Figure 1. "Harvey," the cardiology patient simulator

and various precordial movements and auscultatory events of a core curriculum of 20 commonly encountered cardiovascular conditions (Table 1). A recently completed multicenter study involving fourth year medical students has demonstrated that the bedside skills acquired through the use of the CPS in both group sessions with faculty and self-instructional modes do transfer successfully to the bedside examination of patients. The purpose of this report is to describe another use of the CPS in the continuing medical education programs of the American Academy of Family Physicians.

Program Description

A postgraduate medical education symposium entitled "Practical Diagnosis of the Cardiac Patient" was conducted at both the 1979 and 1980 annual scientific sessions of the American Academy of Family Physicians. The major emphasis of the program was on the bedside diagnostic skills used in evaluating patients with suspected cardiovascular disease. Eight sessions of approximately four hours' duration were held with an average attendance of over 200 physicians. Over the two meetings, a total of more than 1,500 physicians

Table 1. Core Curriculum of Cardiology Patient Simulator

Normal
Innocent murmur
Hypertension
Angina pectoris
Mitral valve prolapse
Mitral stenosis
Mitral regurgitation, chronic
Aortic stenosis
Aortic regurgitation
Cardiomyopathy
Idiopathic hypertrophic subaortic stenosis
Atrial septal defect
Ventricular septal defect
Patent ductus arteriosus
Primary pulmonary hypertension
Mitral regurgitation, acute
Ventricular aneurysm
Mitral stenosis and regurgitation
Pulmonary stenosis
Coarctation of the aorta

participated. Although the audiences were large, the use of individual stethophones for cardiac auscultation and closed circuit television monitors for visualization of the cardiology patient simulator's pulses allowed each physician to participate in the evaluation of most of the nonauscultatory, as well as all the auscultatory, physical findings. A panel of clinical cardiologists experienced in teaching with the CPS discussed the significance of each physical finding as well as the pathophysiology, natural history, and management of each disease. Interaction between the audience and the faculty was encouraged. In each four-hour session, many of the cardiovascular problems encountered by the family physician were reviewed, including the innocent murmur, coronary artery disease, hypertension, mitral valve prolapse, chronic rheumatic mitral regurgitation, mitral stenosis, aortic stenosis, and aortic regurgitation.

Evaluation

While the teaching effectiveness of the cardiology patient simulator, when used in a combination of group and self-learning settings at the fourth year medical student level, has been validated by a recently completed multicenter study,⁴ no comparable data on the teaching effectiveness of the

Table 2. Responses to Cardiology Patient Simulator Evaluation Questionnaire (%)		
	Percent Answering in Desired Direction	
	1979 (n=598)	1980 (n=735)
Technical Quality		
Realism of the CPS	99	98
Accuracy and clarity of pulsatile movements	96	92
Accuracy and clarity of auscultation	99	97
Accuracy and clarity of respiratory variation of heart sounds and murmurs	98	97
Accuracy and clarity of synchronization of pulsatile and acoustic events	95	93
Effect of artificiality on learning	86	92
Anxiety because of its complex technology	84	89
Value for Instruction		
Excellent teaching tool	99	99
Effect on motivation to learn	91	93
Holds attention because CPS is innovative	65	62
Makes learning creative	93	90
Promotes discussion with fellow physicians	88	84
Opportunity to repeat concepts	87	91
Learn to perform bedside examination better	87	95
Time needed to use CPS	79	87
Should be regular part of medical school and postgraduate training	86	94
Want to be taught with the CPS in the future	88	97

CPS in large group sessions or with practicing family physicians have been gathered. Because of time constraints and the very nature of the sessions, no attempt was made to rigorously test the teaching effectiveness of the CPS in such a setting; but pre-session and post-session skills examinations were administered, and subjective assessments of audience comprehension were made. Questionnaires designed to elicit the participant's subjective reaction to the teaching usefulness and technical quality of the CPS were also distributed.

The questionnaire contained 11 positively worded statements (eg, "CPS results in a physician feeling better prepared for a bedside examination") and five negatively worded statements (eg, "The CPS reduces the physician's motivation to learn"). Questionnaires were completed by over 1,300 workshop participants. The respondents selected one of five responses (strongly agree, agree, no opinion, disagree, and strongly disagree)

that best described their reactions to the various questions about the simulator.

The results were independently tabulated by the Center for Educational Development of the University of Illinois Medical Center. The percentage of participants who answered in the desired direction (agreement for positively stated items or disagreement for negatively stated items) appears in Table 2. As can be seen, the vast majority of the participants felt that the technical quality of the cardiology patient simulator was excellent and that it was very useful as a teaching tool. In addition, 88 percent of the physicians in 1979 and 97 percent in 1980 would like to be taught with the device in the future. Many also expressed the desire to work with the CPS in an individual, hands-on learning experience. The very positive acceptance of the CPS was also confirmed independently by a survey carried out by the American Academy of Family Physicians. They found that, among all

those presented at the scientific sessions, the CPS training programs were ranked highest by their membership.

Discussion

Unfortunately, many postgraduate educational activities center solely around listening to lectures, a passive and less than ideal way of learning. Simulation technology can provide a much more interactive and dynamic environment for learning. In fields other than medicine, simulators and simulation techniques have proven to be effective instructional adjuncts, obviating many of the inefficiencies and poorly controlled variables present in teaching in a real-life situation.

In an effort to approximate these situations, simulation techniques have been successfully used in training and testing business executives (business and management games), military personnel (war games and training exercises), professional pilots (the Link trainer), and astronauts (space flight simulation). Despite the widespread familiarity with the principles that underlie these intriguing devices and their proven effectiveness, simulation techniques only recently have been introduced into medical education.⁴⁻¹⁷ In cardiology, cardiopulmonary resuscitation manikins and heart sound simulators are widely used. Such devices, however, limit learners to practicing isolated skills, while the cardiology patient simulator can be used to present realistic patient simulations involving a variety of cognitive and psychomotor skill interactions. When it is used with an appropriate faculty, one not only learns bedside skills but also is provided the opportunity to relate observations to the "patient" and the clinical problem and to arrive at decisions for further evaluation and/or management.

The present study indicates that the cardiology patient simulator is perceived as being realistic and capable of making learning more creative. The participants were nearly unanimous in their feeling that the CPS was an excellent teaching tool and that they would like to be taught by the device again in the future. Since cardiovascular disorders constitute a major portion of the health problems in the United States and most patients are seen and managed by family physicians, an emphasis on training in cardiology for this group is appropriate. Because of very recent developments in medical technology and in medical understanding

of the diagnosis and treatment of cardiovascular disorders, a major portion of the family physician's current knowledge must be gained through ongoing self-study and by continuing medical education programs. Unfortunately, some continuing medical education programs are not so effective as they might be, and based on the data described, the CPS has a great potential for providing an innovative, well-received, interactive type of postgraduate medical education.

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