Teaching Blood Pressure Measurement: CD-ROM Versus Conventional Classroom Instruction

Michael Bauer, M.Geront, BA, Dip. Ed, RN and Mary Huynh, MEd, B. App Sci, RN

Blood pressure (BP) measurement using the standard technique of the mercury sphygmomanometer and stethoscope remains a common procedure in clinical nursing practice and it continues to form the basis for many clinical decisions. Measuring BP accurately requires a high level of skill (Edwards, 1997) and compliance with the recommended steps of the procedure (National Heart Foundation, 1997). However, literature shows that not only is nurse practitioners' knowledge and performance of BP measurement poor (Gillespie & Curzio, 1998; Kemp, Foster, & McKinlay, 1994), but nursing students also lack understanding and fail to perform the procedure correctly (Bogan, Kritzler, & Deane, 1993; Torrance & Sergison, 1996a, 1996b).

To facilitate the learning of this skill the authors developed a multimedia self-instructional CD-ROM tutorial program. This program explained the theory of BP, demonstrated the measurement procedure, and provided simulated practice opportunities and post tests to facilitate students' learning of the skill. This program was designed to enable students to learn the procedure at their own pace in the simulated computer environment before measuring BPs on patients.

CD-ROM seemed an ideal medium by which to illustrate and convey the various abstract aspects of BP and its measurement because the content could be presented visually as well as orally and full use could be made of sounds, photographs, animated graphics, and video. An important feature of this technology is that it is interactive, self-paced, and flexible enough to be suitable for use in an open-learning environment. CD-ROM could also provide a demonstration of the measurement procedure that could be repeated as many times as the student required to master the procedure. In addition, it would permit the measurement procedure to be simulated using realistic sounds, thereby exposing students to a wide range of BPs under controlled measurement conditions.

There are many studies that claim the use of computer assisted instruction is an equally effective alternative to conventional methods of teaching (Edward, 1996; Halloran, 1995; Koch & Guice, 1989; Lo, Lo, Wells, Chard, & Hathaway, 1996; Mangione, Nieman, Greenspon, & Margulies, 1991). The use of this technology to teach psychomotor skills in the classroom has also received some support (DeAmicis, 1997; Froman, Hence, & Neafsey, 1993; Mangione et al., 1991).

Few studies have found computer assisted instruction to be superior to traditional forms of teaching; however, many positive learning outcomes have been attributed to the use of multimedia computer technology. These include reduced learning time (Napholz & McCassee, 1994), a positive change of attitude to learning (Koch & Guice, 1989; Schare, Dunn, Clark, Soled, & Gilman, 1991; Wong, Wong, & Richard, 1992), increased motivation to learn (Lo et al., 1996) and greater enjoyment and increased self-confidence (Glaydura, Michelman, & Wilson, 1995).

OVERVIEW

This article reports a follow-up study that investigated the effectiveness of this CD-ROM tutorial in helping nursing students learn the recommended BP measurement procedure. A previous study by Bauer and Huynh (1998) investigated 27 first-year nursing students' adherence to the recommended auscultatory BP measurement procedure following three different forms of instruction: a conventional lecture and classroom demonstration of the technique, the CD-ROM tutorial program, and a combination of both methods.

The results of this pilot study indicated that while the CD-ROM appeared to be no substitute for real life, hands on experience, it could enhance learning, particularly when used in conjunction with the traditional teaching method. The present study sought to replicate and validate the previous investigation using larger numbers of students and more rigorously trained observers.

The conventional form of instruction entailed teaching groups of 20 or more students at a time. Dual earpiece stethoscopes were used to assist students to recognize the sounds and students practiced on each other. The measurement technique using the stethoscope and sphygmomanometer is a composite of 16 discrete steps: (1) Washing hands; (2) Explaining the procedure; (3) Positioning the person and arm; (4) Checking that the sphygmomanometer is working and at eye level; (5) Selecting the correct cuff size; (6) Applying the cuff over the artery; (7) Palpating the radial artery; (8) Determining the palpated systolic pressure (PSP); (9) Deflating the cuff and waiting 30 seconds; (10) Palpating the brachial artery; (11) Lightly placing the...
stethoscope bell over the artery; (12) Inflating the cuff to 30 mm above the PSP; (13) Deflating the cuff at 2 mmHg/sec; (14) Deflating the cuff once the sounds have been determined; (15) Removing the cuff, and (16) Recording the BP values. Each of these steps needs to be adhered to correctly if errors in measurement and discomfort to the patient are to be avoided.

OBJECTIVE

To determine the efficacy of the CD-ROM as an instructional medium, an experimental design was used to investigate the following two research questions. (1) Will students who learn the BP procedure by both CD-ROM and the conventional form of instruction adhere more closely to the recommended steps of the procedure than students who learn by the conventional form of instruction only? (2) Will students who learn the BP measurement procedure by CD-ROM only adhere more closely to the recommended steps of the procedure than students who learn by the conventional form of instruction?

METHOD

Participants

Three first-year nursing students' tutorial groups were randomly selected to participate in the study. Students in each tutorial group were informed that the authors wanted to check their recall of BP measurement following different forms of teaching in order to evaluate teaching methods. Students were assured that this was not a test and that they would not be disadvantaged in any way. Students in the CD-ROM only group were guaranteed a conventional teaching session after the study. All students (n=73) agreed to participate in the study. The majority of the subjects were female (94%) with ages ranging from 17 to 45 years. The median age was 19 years. None of the students had any prior knowledge or experience of the BP measurement procedure.

Process

Each tutorial group of students was randomly assigned into one of three treatment groups. Group A (n=23) viewed the CD-ROM only. Group B (n=23) received the conventional form of instruction as well as viewing the CD-ROM. Group C (n=21) received the conventional instruction only. All students attended a 2-hour scheduled lecture on the theory of BP followed by 3 hours of instruction according to the assigned treatment group. Teaching occurred during the normal allocated classroom time. Three students from Group A withdrew from the study during the scheduled observation period leaving only 23 students in this group. As the number of computers with CD-ROM drives were limited, students using the CD-ROM worked in groups of two or three.

Group A learned the BP measurement procedure by CD-ROM over 1.5 hours. This group also received 30 minutes of supervised practice time to become acquainted with the equipment, in addition to a 1-hour tutorial class where questions and issues relating to vital signs and BP measurement were discussed. Group B used the CD-ROM during a scheduled 1-hour tutorial class. Two days later this group attended the conventional 2-hour practice laboratory where the procedure was demonstrated by a tutor and where students then practiced the technique on each other. Group C received a conventional 2-hour practice laboratory, in addition to a 1-hour tutorial class that addressed issues related to vital signs and BP measurement.

At the conclusion of the teaching period, students in all groups were observed as they performed the procedure. Their performance was documented using a checklist that was developed by the authors and based on the 16 steps of the procedure. Observations were carried out by four registered nurse clinical teachers who had been trained in the use of the checklist until a 95% consistency between observers had been achieved. All the volunteers who had their BPs measured were nursing students not involved in the study. They were positioned supine on beds with their arms extended and sphygmomanometers were placed conveniently close by. Each volunteer was screened by drawn curtains. All students were assigned designated observation times and a 5-minute interval was allowed between students to avoid contamination of subjects. Students were directed to measure the volunteer's BP and were coached by the observer if necessary, so that they could continue on to the next step of the procedure. Steps that were completed satisfactorily were recorded with a tick and steps that required coaching to complete, or were performed incorrectly, were recorded with a cross.

Analysis

To compare observations of students' adherence to the 16 steps of the measurement procedure, the chi-square test was used. Data were analyzed using SPSS and results were recorded to two decimal places. The significance level was set at P=.01 (Folgar & Thomas, 1995).

RESULTS

The CD-ROM only group (Group A) adhered to only 2 of the 16 steps of the procedure, step 3 (9.78; P=.00) and step 16 (7.35; P=.01). Students' adherence was particularly poor for steps 1 (9.78; P=.00), 2 and 4 (15.70; P=.00), 5 (19.17; P=.00), and 8 (5.26; P=.03). The x² and significance values for the remaining steps were as follows: 6 (1.09; P=.40), 7 (0.39; P=.68), 9 (0.04; P=1.00), 10 (2.13; P=.21), 11 (1.09; P=.40), 12 (1.09; P=.40), 13 (3.52; P=.93), 14 (1.09; P=.40), 15 (3.52; P=.93).

Both Group B (CD-ROM plus conventional instruction) and Group C (conventional instruction) adhered to steps 3 (nil; 15.38), 6 (13.76; 9.85), 7 (nil; 15.38), 9 (17.19; 7.54), 12 (10.71; 7.54), 14 (nil; 12.46) and 16 (17.19; 12.46) at P=.01, respectively. Group B is notable in that all students correctly completed steps 3, 7, and 14 and only this group adhered to step 8 (17.19; P=.00) and step 13 (10.71; P=.00). Step 4 was done poorly (0.43; P=.66), while step 15 was completed by 15 students, but was not significant (3.86; P=.09). Step 11 was not adhered to by 17 students (8.05; P=.01).

Group C was unique in being the only group to adhere to steps 4 (7.54; P=.01) and 15 (7.54; P=.01). All three groups (A, B, and C, respectively) were poor in their adherence to step 1 (9.78; 10.71; 9.85; P=.00), 2 (15.70; P=.00), 4 (0.43; P=.66), 5 (19.17; P=.00), 6 (3.86; P=.08, 2.46, P=.17), 10 (2.13; P=.21), 12 (3.52; P=.93), and 11 (1.09, P=.40; 8.05, P=.01; 1.38, P=.33).

DISCUSSION

The primary purpose of this investigation was to ascertain nursing students'
degree of adherence to the recommended steps of the BP measurement procedure, rather than the accuracy of the final BP values obtained. Students who learned BP measurement primarily by CD-ROM (Group A) did not demonstrate greater adherence to the recommended steps of the procedure than students who received either the conventional form of instruction or a combination of both methods. This group adhered poorly to all steps of the procedure with the exception of step 3 and step 16, suggesting that students' learning gains one day after using the CD-ROM for 1.5 hours were minimal.

These findings challenge an earlier suggestion by the authors (Bauer & Huynh, 1998) that CD-ROM alone may be a suitable alternative to the conventional form of teaching and suggest that students who learn the procedure by CD-ROM alone do not adhere more closely to the recommended steps of the procedure than students taught the conventional way.

Satisfactory completion of step 16 (recording the BP values) was an expected outcome for all three groups given that obtaining a BP is the generally recognized aim of the measurement procedure. The few students who did not complete this step left the room without recording their BP findings.

Step 3 was a preparatory step which required little effort on the part of the student and as expected, all three groups did this step well. Volunteers were supine and their arms were generally positioned by their side. Students only had to expose the arm sufficiently by rolling up the sleeve and then supinate the limb.

Group B (CD-ROM and conventional instruction) and group C (conventional instruction) each completed 9 steps of the procedure, however, group B was exceptional in achieving 100% compliance on three of these steps. This outcome suggests that students who learn BP measurement by both CD-ROM and the conventional form of instruction adhere more closely to the steps of the procedure than students who learn by the conventional form of instruction.

Both group B and group C completed steps 3, 6, 7, 9, 12, 14, and 16. It should be noted that group C was observed the day of being taught and it is possible that the recency of teaching may have been a factor in their performance. It is notable that only the CD-ROM plus conventional teaching group (group B) adhered to step 8 (determining the PSP prior to auscultation) and step 13 (deflating the cuff at the recommended rate of 2 mmHg/sec), steps that are often overlooked in real practice (Bogan et al., 1993; Fraser, 1989; Torrance & Serginson, 1996a, 1996b). Adhering to these steps in practice is predominantly dependent on understanding the theory of Korotkoff sounds and the effect of cuff inflation and deflation on the dynamics of blood flow. Group B's better adherence to these two steps may have been because of the extra reinforcement of the theory and measurement technique provided by the CD-ROM.

Group C's superior performance in step 4 (checking the equipment) and step 15 (removing the cuff upon completion of the procedure) is anomalous because they had less reinforcement of the procedure than group B. Although group B came close to significance in step 15 (0.08), step 4 was performed poorly and one would have expected a better performance by this group. Remarkably neither group B or C washed their hands (step 1), explained the procedure (step 2), checked for the appropriateness of the cuff size (step 5), located the brachial artery prior to applying the stethoscope (step 10), or used the bell of the stethoscope (step 11).

Students' lack of adherence to steps 1, 2, and 5 can to some extent be attributed to the scenario created for the observational part of this study. Students were ushered into the room and asked to demonstrate on their peers what they could remember of the procedure. It is possible that this "artificial" context shifted the students' focus from the preparatory steps to the procedural task. There was also only one cuff size available and invariably this was the appropriate size for the volunteers' arms.

Although cuff size is a significant determinant of the BP obtained, it is likely that the lack of choice in this area influenced students' behavior with this aspect of the procedure. Those students who did adhere to this step checked the available cuff dimensions against the volunteer's arm.

It is not apparent why a significant number of students chose not to determine the exact location of the brachial artery before positioning the stethoscope. It is possible that students may have felt confident about the anatomical location of the artery and their ability to place the stethoscope correctly.

Remarkably, most students in both groups B and C did not use the bell of the stethoscope for auscultation (step 11), even though it is universally recommended for listening to low pitched Korotkoff sounds (Estes, 1998). Poor compliance with this step is consistent with other research investigating nursing students' BP measurement technique (Torrance & Serginson, 1996a) and it would appear to mirror the authors' experience of what occurs in real practice.

Group B's failure to adhere to this step (P<0.01) could in part be attributable to inconsistent teaching and negative reinforcement of the incorrect procedure. Although the importance of using the bell was explained to students, the tutor subsequently demonstrated the procedure using the diaphragm and students consequently practiced in this way. Remarkably, the majority of group A correctly used the bell in this step although not to a significant degree, indicating that this group was probably not as contaminated by poor role modeling.

CONCLUSION

The instructional multimedia CD-ROM involved in this study was developed as a self-paced and self-directed learning medium that would allow students to learn BP measurement in their own time and at their discretion. This research indicates that, used in isolation and in lieu of a traditional class, CD-ROM is not an effective teaching method, although it may have the potential advantage of being able to convey some procedural steps more effectively in a more accurate and unbiased way. However, when used as an adjunct to conventional teaching, the CD-ROM seems to have tangible benefits for students learning the BP measurement procedure in terms of conveying the theory and reinforcing the steps of the procedure.

Further research is needed to determine the long-term benefits of learning with CD-ROM and using CD-ROM technology both inside and outside the classroom to optimize learning.
REFERENCES


Look Into the Face Of
Extraordinary Health Care
MEMORIAL HERMANN HOSPITAL
is a member of the prestigious Memorial Hermann - one of the largest not-for-profit healthcare networks in Texas. Located in Houston, it is a tertiary care hospital in the world-renowned Texas Medical Center, and serves as the primary teaching affiliate for the University of Texas School of Medicine.

NEURO EDUCATOR
Excellent opportunity for an experienced RN with a strong background in Neuro nursing. BSN required. A Master's degree and/or CCRN Certification preferred. Education experience a plus.

Memorial Hermann Hospital has been recognized by U.S. News & World Report as one of the best hospitals in the nation.

An outstanding compensation and benefits package are offered, including relocation assistance to cosmopolitan Houston, one of the most dynamic and affordable cities in the nation.

Resumes may be faxed to 713/704-5599 or mailed to: MEMORIAL HERMANN, Human Resources/Employment, 6411 Fannin, Houston, Texas 77030-1501 or call 800/231-1004 to speak with a nurse recruiter.

For Your Whole Career.
MEMORIAL HERMANN HOSPITAL
HOUSTON, TEXAS