

RESEARCH ARTICLES

A Comparison of the Acceptability and Effectiveness of Two Methods of Distance Education: CD-ROM and Audio Teleconferencing

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Objectives. To fulfill a need for convenient and effective continuing education for pharmacists throughout Wisconsin by developing a pharmacy continuing education program using 2 different methods for distance education: audio teleconferencing and CD-ROM.

Methods. Eighty pharmacists were recruited from a 2003 University of Wisconsin distance education program, 47 of whom participated in the course using the traditional audio teleconference method, and 33 of whom participated using a home study CD-ROM containing the same material presented in the teleconference. Volunteers were required to complete a pretest, a first posttest immediately following completion of the continuing education course, a second posttest 1 month following the conclusion of the course, and an evaluation.

Results. The CD-ROMs were a more acceptable method for distance education than audio teleconferencing and resulted in better retention of the course information.

Conclusion. These study results can help coordinators of continuing pharmaceutical education programs to determine the most effective and acceptable method for future distance-education opportunities.

Keywords: distance education, continuing education, audio teleconferencing, CD-ROM instruction

INTRODUCTION

From 1968 to 2001, Extension Services in Pharmacy at the University of Wisconsin-Madison School of Pharmacy used the Educational Teleconference Network (ETN) to provide distance-education experiences for pharmacists in Wisconsin. ETN utilized an amplified telephone signal to share information among groups of individuals assembled at various distant locations throughout the State.¹ ETN provided a relatively cost-effective and efficient method for the delivery of continuing education (CE) to an average of 421 pharmacists each year for the annual fall pharmacy CE offering, at an average of 72 sites throughout Wisconsin. These averages are based on enrollments and sites from the last 15 years of ETN programming. These annual enrollments represented 15 % to 20% of the registered pharmacists in Wisconsin. Advantages of ETN included: (1) convenience for pharmacists; (2) a relatively inexpensive delivery method for program developers; (3) a flexible means for reaching sites in states adjacent to Wisconsin; and (4) the availability of at least one listening location in each of the 72 counties in Wisconsin. Each Tuesday evening during

the 8-week program, a prerecorded lecture was broadcast on a designated phone line. An open microphone, live question-and-answer session followed each broadcast. Pharmacists were able to access the annual program over the ETN system; most from within 10 miles of their home or workplace. Due to increased costs to maintain the system and decreased usage by other University departments, the State abandoned the ETN system in June 2002.

The loss of the ETN system has provided Extension Services in Pharmacy with a unique opportunity to fulfill its mission to provide CE opportunities to pharmacists in Wisconsin regardless of their proximity to a listening location. Live programs held in Madison and Milwaukee continue to serve the areas of the state where pharmacists are concentrated; however, ETN traditionally provided pharmacy continuing education for the remainder of the State. Thus, alternative methods of delivery to distant portions of Wisconsin were sought.

2002 Fall Teleconference Study

To continue offering the teleconference format for pharmacists after the abandonment of the ETN system, Extension Services in Pharmacy initiated a conference call, using a State-operated system (WisLine), as an alternative delivery system in fall 2002. This delivery system was similar to the previous teleconference system and

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making the changes virtually transparent to pharmacist participants. The 8-lecture broadcast, "An Update on Drug Interactions," was originally planned for 72 listening locations (1 per county); however, due to budget constraints and security issues that required an aide to be present at each listening location, most of the county sites were not available for evening broadcasts. To compensate for the loss of these public sites, several private sites, including hospitals, were recruited to provide listening locations. At the time of the first WisLine broadcast in September 2002, 16 public sites (out of the original 72 county sites) and 16 private sites were available.

To help meet the needs of Wisconsin pharmacists unable or unwilling to attend one of the 32 available sites, a CD-ROM was produced containing the same course material as that broadcast over the WisLine system. The CD-ROM contained *PowerPoint* slides with a voice-over lecture track for each presentation. Because the course was originally marketed with the option of attending at one of the original 72 listening locations, 67 pharmacists outside a reasonable driving distance of the 32 remaining available listening sites were offered the option of either a full refund or the CD-ROM version of the course. Without exception, all of those pharmacists chose to take the course using the CD-ROM method rather than obtain a refund. A CD-ROM, course workbook, final examination, and course evaluation were mailed to 67 pharmacists prior to the first broadcast. Of the 350 pharmacists who originally registered for the WisLine program, 283 continued to participate via the audio teleconference, using course workbooks containing copies of the speakers' slides and a live question-and-answer session following each lecture.

CD-ROM technology, similar to online educational programming, offers the advantage of participation at any time and any location (ie, at work or at home). Also, like traditional home study courses, online or CD-ROM programming can be completed at a pace that is comfortable for the individual learner. Numerous studies have looked at online instructional materials versus face-to-face instructional programs and the findings may be applicable to CD-ROM programs versus live teleconferences. Studies comparing face-to-face instruction and online learning have found no significant differences in effectiveness of learning for college students and younger learners.²⁻⁵ Other studies have evaluated the benefits of digital instruction for health professionals, including effectiveness as measured by changes in pretest and posttest measurements.⁶⁻¹⁰ However, only 1 study could be identified that compared face-to-face instruction with computer-based training for practicing health professionals.¹¹ In that particular study, there were no significant differences in either students' acceptance of or the effectiveness of the

2 methods. No studies were found that compared audio teleconferencing with asynchronous digital formats.

In a separate study of pharmacists participating in the 2002 program, CD-ROM technology was compared with the audio teleconference system broadcast.¹² Course evaluations for pharmacists participating in the traditional audio-teleconference program (n = 212) were compared with those pharmacists opting for the same course materials on CD-ROM (n = 67). For both groups, the average response rate was 82%. Teleconferencing and CD-ROM technologies were rated the same on the majority of the evaluation questions. Differences identified included: (1) the audio quality was rated higher on the CD-ROMs than for the teleconference, which involved telephone line transmission ($p < 0.05$); (2) the lectures recorded on CD-ROM were rated as more effective than the lectures via audio teleconference ($p < 0.005$); and (3) the same course content presented on CD-ROM was perceived as more beneficial than by teleconference ($p < 0.005$). In contrast, the pharmacists' median response when asked the value of using 2-way audio teleconferencing for question-and-answer sessions to clarify points of the lecture (not available to CD-ROM learners) was "uncertain".

2003 Fall Teleconference Study

Based on the results of both the course evaluations and the previously reported 2002 study, along with the experiences of using this dual system of providing continuing education to Wisconsin pharmacists, it was decided that the same 2 methods would be offered for the 2003 fall program. However, in advance of marketing the program, listening sites were recruited throughout Wisconsin and a CD-ROM program was immediately prepared for those unable or unwilling to attend the teleconference sites. The course brochure offered pharmacists the choice of either attending the traditional teleconference or completing the CD-ROM program, regardless of their geographical location or proximity to a listening site.

The 2003 course, *A Review of Selected New Drugs in the Beginning of the 21st Century*, continued the traditional format of 8 lectures. Both groups of pharmacists (CD-ROM and teleconference) had access to the live question-and-answer session. Pharmacists receiving the CD-ROM format were given a toll free number and approximate times to call, enabling them to join the teleconference participants for each of the question-and-answer sessions immediately following each of the 8 lectures. Extension Services in Pharmacy successfully recruited and made available to pharmacists a total of 37 potential listening locations. When the course began, pharmacists participated at 28 listening locations and attendance at these locations ranged from 2 to 13 pharmacists.

In addition to the presentation of the same course material using 2 different delivery systems, a more rigorous study was designed and executed to evaluate not only the acceptability of CD-ROM home study courses as compared to audio conferencing (similar to the 2002 study), but also the effectiveness of the 2 delivery methods in improving pharmacists' knowledge. The objectives of this study were to: (1) develop and present a pharmacy continuing education program using 2 different methods for distance education; (2) evaluate the acceptability of the 2 delivery systems; (3) measure and compare the amount of cognitive gain using the 2 delivery methods; and (4) examine the impact of selected demographics on acceptability and cognitive changes.

METHODS

The identical pharmacy continuing education program was offered using either a home study CD-ROM (with optional access to the live question-and-answer participation) or an audio teleconference program with a live question-and-answer session following each lecture. Participation in the live question-and-answer session was also optional to teleconference participants since they could leave the location prior to the start of the question-and-answer session. All course participants were required to complete a posttest and an evaluation form. Additional requirements for study volunteers were the completion of a pretest and second posttest. Pharmacists who registered for the course were asked to volunteer for the study and were offered a 15% discount on course tuition as an incentive to volunteer. The study was submitted to the University of Wisconsin Health Sciences Institutional Review Board, where it received exempt status.

To measure cognitive change, pharmacists were presented with 2 parallel examinations of course materials before and after participation in the course (a pretest-posttest design with one of the parallel tests serving as the pretest and the second parallel test serving as the posttest). Development of the 2 examinations consisted of obtaining 10 questions from each lecturer, for a total of 80 questions. These questions were administered to a volunteer group of 9 Madison hospital pharmacists who did not register for the course; the difficulty of each question was evaluated by testing these volunteers. The 2 easiest and the 2 most difficult questions for each lecture were eliminated and the remaining 6 questions per lecture were randomly divided into the pretest and posttest questions, resulting in at least 3 questions for each lecture. Two questions were randomly selected from the 16 most difficult questions to complete the 25-question pretest and posttest.

The extent of each pharmacist's participation in the program was taken into consideration. Only pharmacists

reporting participation in a minimum of 7 lectures were included in the study. The volunteer pharmacists were classified into 2 categories based on course format participation: audio teleconferencing or CD-ROM. Assessment of the pharmacist's satisfaction with both the delivery system and course content required that a course evaluation form be completed and returned at the end of the program. Pharmacists' acceptance of each delivery system was assessed using a series of 5-point Likert scale questions. Effectiveness of the 2 delivery systems was assessed by measuring change in pharmacists' knowledge (posttest vs. pretest scores). Figure 1 illustrates the timeline for the study methodology.

Data were analyzed using *Minitab* software (Release 12, Minitab Inc., State College, Penn). In most cases, the evaluation results reported in the tables are presented as means, for ease of comparison. However, since the evaluation statements were scored on a 5-point ordinal scale, statistical analysis required the use of non-parametric procedures, primarily the Mann-Whitney U and Kruskal-Wallis tests. For cognitive test results, parametric 2-sided *t* tests and analysis of variance tests were used. Where chi-square tests were performed on a 2 x 2 contingency table, the Yate's correction for continuity was used.¹³ Unless otherwise specified, all tests were performed with a 95% level of confidence ($p \leq 0.05$).

RESULTS

A total of 297 pharmacists and other health professionals enrolled in the course: 172 chose the audio teleconference and 125 participated via CD-ROM. There were 270 evaluations returned (156 from teleconference participants and 114 from CD-ROM users), representing a total response rate of 90.9%.

Since study participants volunteered to take an additional examination (the pretest), the first inquiry was to determine whether the study participants differed significantly

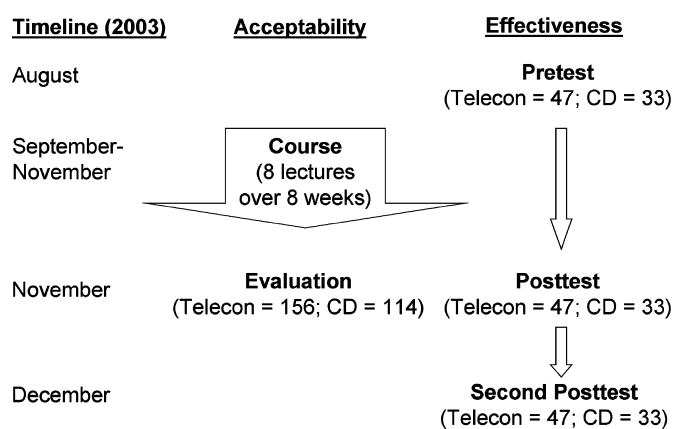


Figure 1. Timeline of Study Methodology.

from the non-study participants with respect to demographics or evaluation results. No significant differences were found based on the demographic information obtained on the evaluation form: academic degree, bachelor of science (BS) vs. doctor of pharmacy (PharmD) or advanced degree ($p = 0.912$); years of pharmacy practice ($p = 0.700$); practice setting, institutional vs. retail ($p = 0.466$); practice position, management vs. staff ($p = 0.219$); for teleconference participants, the distance traveled to listening location, above vs. below the median miles ($p = 0.276$); and for CD-ROM participants, previous participation in an ETN program ($p = 0.208$). In addition, there were no differences in responses to all 15 evaluation statements discussed below (p values varied from 0.063 to 0.97). Thus, for analysis of method acceptability, all of the usable 270 evaluations were considered for the 2 delivery methods (course evaluations) and only the study participants ($n = 80$) were used for evaluating the effectiveness (test results) of the CD-ROM method compared to the teleconference format.

Demographics

The majority of the pharmacists participating in the 2003 distance education experience had BS degrees (89.3%), held staff positions (73.3%), were from institutional settings (61.8%), and had 20 or more years of practice experience (60.8%). For those choosing the teleconference option, the average roundtrip traveling distance to the 28 listening locations was 14.1 miles (ranging from less than 1 mile to 100 miles roundtrip each

night). These variables were evaluated to determine any relationships among the demographics. There was a significant relationship between academic degree and years of practice experience ($\chi^2 = 33.03, p < 0.001$), with 51.8% of the advanced degrees held by pharmacists with 10 or less years of experience. All other comparisons among the various demographic variables showed statistical independence. Also, the vast majority (92.0%) of those choosing the CD-ROM option had previously participated in at least 1 audio teleconference program. Table 1 compares the demographics for those who chose the CD-ROM delivery method with those who chose teleconference delivery method. Demographically, there were no significant differences between the 2 volunteer groups based on the delivery system chosen, except for the number of years of professional practice. Pharmacists choosing the CD-ROM format had significantly fewer years of practice than their more senior counterparts who chose the audio teleconference (Table 1).

From a list of possible motives, participants were asked to choose their top 3 reasons for participating in the distance-education program. Results were weighted by 3 for the first choice, 2 for the second choice, and 1 for the third choice. Based on pharmacists' top 3 reasons for attending continuing education programs, the most popular reason was to enhance their general pharmacy knowledge. Of the 252 pharmacists responding to this section of the survey, 97.2% chose enhancing knowledge as one of the top 3 reasons for participating in continuing education. Fulfillment of continuing education requirements

Table 1. Comparison of Demographics Between Pharmacists Participating in a Continuing Education Course Delivered by Teleconference and CD-ROM

	Teleconference, No. (%)	CD-ROM, No. (%)	P*
Highest academic degree			
BS	132 (92.3)	93 (85.3)	0.076
Advanced Degree (MS, PharmD, etc)	11 (7.7)	16 (14.7)	
Total years of pharmacy practice			
10 years or less	18 (12.5)	21 (19.8)	0.066
11-20 years	31 (21.5)	28 (26.4)	
20-30 years	53 (36.8)	40 (37.7)	
31+ years	42 (29.2)	17 (16.0)	
Years - Mean (\pm SD)	25.3 (10.2)	20.9 (10.7)	0.001
Employment setting			
Institutional	83 (63.4)	56 (59.6)	0.565
Retail	48 (36.6)	38 (40.4)	
Employment position			
Management	37 (28.2)	23 (24.5)	0.528
Staff	94 (71.8)	71 (75.5)	

*Statistical tests used were 2-sample t test for continuous outcome (years) and chi-square test for discrete outcomes (with Yate's correction for 2 x 2 designs)

(83.7%) was second among the top 3 reasons. Education as part of their professional responsibilities (73.8%) was third, followed by gathering information in more depth or detail (25.8%), networking opportunities (9.1%), getting help with a specific problem (2.7%), and development of a specialty pharmacy practice (2.7%). With respect to the order of importance, these results were similar to the findings in a similar study of Wisconsin pharmacists and their attitudes toward the availability and acceptability of various distance-education delivery systems.¹⁴ When reasons for attending responses were divided by the method of delivery chosen, the results were almost identical between the 2 groups. One obvious difference was that no one who enrolled in the CD-ROM version chose “network and/or meet with colleagues” as a reason for participating, whereas this response represented the fifth most popular reason for teleconference participants.

Evaluation of the Presenters

As measured over the last 5 years, there has been little variability in the pharmacists’ opinions of the overall value and effectiveness of the speakers for those participating in the audio teleconference (Table 2). There was more variability with respect to the depth of the presentations ($F = 3.30, p = 0.04$), but there were no significant differences with respect to the value of the presentations (an overall median response of 4 = “valuable”) and the effectiveness of the lecturers to present their course materials (overall median response of 4 = “effective”). As mentioned previously, in 2002 the pharmacists felt that the lecturers were more effective using CD-ROMs ($p < 0.005$). However, in 2003 there were no significant differences between the teleconference and CD-ROM respondents with respect to the composite evaluations for all

8 speakers, even though the mean response was slightly higher for the CD-ROM participants ($p = 0.33$). There was no significant difference between teleconference and CD-ROM participants with respect to their evaluation of either the value of the presentations ($p = 0.18$) or the depth of the presentations ($p = 0.26$). Due to variability in speaker style and each speaker’s comfort with distance education, individual lecturers were not evaluated in this study; only a composite score for all 8 lecturers is reported.

Acceptability and Effectiveness

Table 3 summarizes participants’ responses to a series of 15 evaluation questions. Most were general questions for both delivery systems, but some were specific for either the teleconference or CD-ROM method. For this study, effectiveness was measured by evaluating the change in the pharmacists’ scores (posttest vs. pretest scores). Volunteers were required to complete and return the pretest prior to receiving any of the course materials to prevent the review of course materials prior to taking the pretest. Participants were required to take the posttest after completing the course. However, when the posttest was returned for grading, it was discovered that an error had been made in preparing the posttest materials. The pretest and posttests both contained the same test questions, instead of the posttest containing a parallel set of test questions. The study investigators decided to mail the volunteers a second posttest (consisting of the alternate set of questions) 1 month following the conclusion of the course. Since many pharmacists completed the final examination as they listened to the lecture (via either teleconference or CD-ROM), often treating it as an open-book examination, it was felt that this second posttest might actually provide a better assessment of the pharmacists’ learning. As seen in Table 4, results from the later test (labeled “Second Posttest”) were slightly lower than the immediate final examination results (labeled “First Posttest”).

Table 2. Comparison of Five Years of Teleconference Speaker Evaluations

Year	n	Mean Response (SD)*		
		Value	Effectiveness	Depth
1999	457	4.12 (0.68)	3.89 (0.77)	3.37 (0.5)
2000	389	4.14 (0.81)	3.92 (0.86)	3.33 (0.7)
2001	347	4.05 (0.74)	3.92 (0.73)	3.39 (0.54)
2002	244	3.98 (0.86)	3.80 (0.88)	3.49 (0.58)
2003	156	4.03 (0.85)	3.89 (0.84)	3.46 (0.73)
Statistical Comparison†		F = 2.21 p = 0.11	F = 1.01 p = 0.37	F = 3.30 p < 0.04

Based on 5-point Likert scales: value (1 = not valuable to 5 = very valuable), effectiveness (1 = not very effective to 5 = very effective), and depth (1 = too shallow, 3 = about right, 5 = too deep) †Ideally, a non-parametric test would have been performed on this information, but original data were not available; only previously reported means and standard deviations were available

Limitations

The primary limitation of the study was the use of self-selecting subjects based on either convenience or personal learning styles. Ideally, volunteers would be randomized into these 2 types of distance-education programs. A second limitation is the unequal sample sizes, with more volunteers participating in the teleconference format. Appropriate statistics were used to adjust for unequal sample sizes.

DISCUSSION

Acceptability of the Methods

Although not statistically significant (Table 3), the overall course evaluation ratings given by pharmacists in the CD-ROM group were higher (median of 5 = “very

Table 3. Response to Evaluations Completed by Participants in a Pharmacy Continuing Education Course

	Teleconference, Mean (SD)	CD-ROM, Mean (SD)	P*
Responses based on a 5-point Likert Scale (5 = very satisfied, 1 = very dissatisfied)			
The subject matter of the course	4.34 (0.59)	4.47 (0.63)	0.093
The value of the handout material to complement the lectures	4.40 (0.64)	4.40 (0.75)	0.990
Audio quality	4.30 (0.68)	4.24 (1.03)	0.620
Video quality of the CD-ROM	—	4.60 (0.51)	—
The CD-ROM program was user friendly	—	4.75 (0.47)	—
The physical facilities at your listening location	4.41 (0.64)	—	—
The technique as a means of obtaining “in depth” continuing education	4.26 (0.71)	4.59 (0.59)	<0.001
The value of the question session in clarifying certain points in the lecture and providing further information	3.98 (0.73)	—	—
Responses based on a 5-point Likert Scale (5 = strongly agree, 1 = strongly disagree)			
Overall, I found this teleconference (or CD-ROM) course to be very worthwhile	4.29 (0.61)	4.61 (0.52)	<0.001
As a result of this program, I have a greater understanding of the some of the significant newer drug therapies	4.27 (0.50)	4.46 (0.50)	0.004
The material covered in this course was directly applicable to my professional practice	4.16 (0.65)	4.20 (0.70)	0.514
The program was presented as a fair and balanced discussion and was not commercial in nature	4.55 (0.51)	4.64 (0.50)	0.143
The stated objectives for this course were achieved	4.27 (0.55)	4.47 (0.55)	0.002
My personal objectives in attending the course were fulfilled	4.26 (0.58)	4.48 (0.55)	0.002
I enjoyed the CD-ROM technology, but would have preferred to attend the live teleconference program. (for those attending a previous ETN teleconference)	—	2.17 (0.90)	—

*Results are reported as mean \pm SD for purposes of comparisons, but statistical evaluation involved the Mann-Whitney U test since the Likert scales represented ordinal scales. Data reported in the text refers to the median responses used in the Mann-Whitney test

satisfied”) than those given by pharmacists in the teleconference group (median of 4 = “satisfied”) with respect to: (1) the subject matter of the course; (2) the value of the handout materials to complement the lectures (both groups received the same workbooks with copies of the speakers’ slides); and (3) the audio quality of each method. With respect to the audio quality, although the mean rating was lower for the CD-ROM, the median rating was higher. Almost 10% of CD-ROM users were dissatisfied with the audio quality of the CD-ROMs, compared to only 2% of teleconference participants who were dissatisfied with the audio quality of the teleconference. Poor audio quality was also the major complaint made by the CD-ROM study group. It is possible that one batch of CD-ROMs was produced at a lower audio quality and this should be monitored more closely for future programs.

Specific evaluation questions designed for CD-ROM users found that the video quality of the CD-ROM and the user friendly nature of the CD-ROM program were “very satisfactory” (each median = 5). At the same time, attendees at the 28 sites were “satisfied” (median = 4) with the physical facilities at their listening locations.

They were also “satisfied” with the value of the question-and-answer sessions in clarifying lecture points or providing additional information related to the course. Only 24 of the CD-ROM course participants indicated that they took advantage of the optional live question-and-answer sessions following each lecture. Those participating in the sessions provided a median response of 4, indicating a similar level of satisfaction with the question-and-answer sessions among both CD-ROM users and teleconference participants.

Since the 2 groups (teleconference and CD-ROM) of users were similar with respect to demographics (Table 1), it was not surprising to find similar responses (medians of 4 = “agree”) when asked if the material covered in the course was directly applicable to their professional practice. Also, both groups considered the course material to be fair/balanced and not commercial in nature (medians of 5 = “strongly agree”).

However, there were several significant differences in the pharmacists’ responses to other questions that were related to the delivery method used in the study. CD-ROM participants (1) were more likely to find the course “very

Table 4. Results on Examinations by Teleconference or CD-ROM Participation*

	Teleconference Participants, (n = 47)	CD-ROM Participants, (n = 33)	Significance
Pretest scores†	45.5 (12.7)	44.6 (12.1)	$t = 0.31, p = 0.76$
Posttest scores† (immediately after program)	93.2 (6.37)	94.6 (4.34)	$t = 1.09, p = 0.28$
Second posttest scores† (one month later)	77.9 (13.1)	83.0 (11.29)	$t = 1.88, p = 0.065$
Changes in test scores‡			
Posttest - pretest	+47.8 (14.6) $t = 22.4, p < 0.001$	+49.9 (12.3) $t = 23.2, p < 0.001$	
Second posttest - pretest	+32.5 (15.0) $t = 14.8, p < 0.001$	+38.4 (13.4) $t = 16.5, p < 0.001$	

*Results reported as mean \pm SD

†2-sample t tests comparing teleconference and CD-ROM participants

‡Paired t tests comparing individual posttest-pretest scores

worthwhile”; (2) felt they had a greater understanding of the significant new therapies discussed in the course; and (3) had a greater sense that their personal objectives were fulfilled. For all 3 questions, the median response from CD-ROM users was “strongly agree,” compared to the median response from teleconference users of “agree”. Although the response from the CD-ROM groups was statistically significant, both groups gave a median response of “agree” to the question about the course achieving the stated objectives. Also, when asked if the particular delivery method used in the study was satisfactory as a means for obtaining “in depth” continuing education, the CD-ROM users provided a median response of “very satisfied,” whereas their audio teleconference counterparts’ responded they were “satisfied”.

Finally, 82 of the CD-ROM users (72%) indicated that they had previously participated in at least 1 audio teleconference program. When asked if they would have preferred to have taken the teleconference version of the course instead of the CD-ROM version, only 4.8% agreed or strongly agreed with the statement. Conversely, 67.0% disagreed or strongly disagreed, indicating a preference for the CD-ROM format.

Effectiveness of the Methods

As seen in Table 4, there were no significant differences in any of the test scores when comparing the 2 delivery systems (teleconference vs. CD-ROM). The pretest scores for both groups were almost identical, averaging around 45% ($p = 0.76$). Correspondingly, the 2 groups showed similar average scores on the first posttest ($p = 0.28$) and the second posttest ($p = 0.065$). Although not statistically significant, the pharmacists using the CD-ROM seemed to retain the course materials better than their colleagues receiving the teleconference, as evi-

denced by the second posttest scores of 83.0% and 77.9%, respectively.

Significant differences were observed when the individual pharmacists’ scores were compared among the pretest and 2 posttests. All pharmacists had a significant increase in the knowledge scores on the first posttest, with teleconference pharmacists increasing 47.8% ($p < 0.001$) and CD-ROM pharmacists increasing 49.9% ($p < 0.001$). As mentioned earlier, the second posttest may have been a better measure of cognitive change because it was not available for pharmacists during the presentations, having been mailed after the first posttest was received from each group. On the second posttest, there was still significant improvement in performance over the pretest by both groups ($p < 0.001$), but the CD-ROM pharmacists showed an average 38.4% increase on their scores, while teleconference pharmacists showed a 32.5% improvement. Although the difference was not statistically significant, the scores suggest that the CD-ROM format was more effective than the teleconference format in terms of participants retaining information presented in continuing pharmacy education programs.

CONCLUSION

The use of either audio teleconferencing or CD-ROM technology appears to offer acceptable and effective methods for providing continuing education to pharmacists over a wide geographical area. Based on evaluation results, the CD-ROM users tended to be more satisfied with the delivery method for obtaining in-depth information. Also, they expressed greater satisfaction with the course meeting its stated objectives, as well as fulfilling their personal objectives in participating in the course. Both methods were equally effective in increasing knowledge, as measured by differences in the pretest and posttest scores.

These study results can help course coordinators determine the most effective and acceptable method for future distance-education opportunities. Although Wisconsin pharmacists were studied, the results of comparing 2 methods of distance-education delivery can be applied by adult educators nation-wide. This information can assist universities choosing among distance-education delivery systems for nontraditional undergraduate instruction or continuing education programs.

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