"A Satellite Primer on Tuberculosis:" A Collaboration in Distance Education

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"A Satellite Primer on Tuberculosis" was offered as a distance-based certificate course on tuberculosis (TB) fundamentals to a national audience of over 5,000 individuals. The course was a collaborative effort of a school of public health, a state health department, and the Centers for Disease Control and Prevention. Instruction was provided through print-based self-study modules that were complemented by live, interactive satellite conferences. Course completers, over 70 percent of whom were nurses and employees of public health departments, scored significantly higher on a course posttest than on a pretest, and the vast majority felt the course provided valuable training.

Key words: *distance learning, satellite conference, self-study module, tuberculosis training*

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AFTER DECLINING steadily for decades, the incidence of tuberculosis (TB) increased by 20 percent between 1985 and 1992. This increase is attributed to a number of factors including the following: (1) the HIV epidemic, (2) immigration from countries in which TB is common, and (3) a higher incidence of TB in settings such as homeless shelters and correctional facilities. Owing to a deterioration of the public health infrastructure, many communities could not respond to the resurgence, and this contributed to further transmission.[1–4] Outbreaks resulting from drug-resistant strains of *Mycobacterium tuberculosis*, some nosocomial in origin, have further complicated control efforts.[3,5]

In response to increases in TB incidence within certain population subgroups in the United States, many state and local health department TB programs received funding increases to strengthen TB prevention and control efforts in those subgroups.[6] A major part of this effort was the addition of a number of new public health workers who were responsible for providing directly observed therapy for patients, performing contact investigation, and providing other TB-related outreach services. Many of these new workers were considered entry level, because they typically were lacking in essential TB knowledge and skills. Because adequately trained personnel represent a critical element of effective tuberculosis intervention efforts, ready access to appropriate training for those personnel was considered essen-

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tial.[7] Unfortunately, this access is increasingly impeded by the competing priorities and budgetary constraints that are facts of life for organizational entities with public health mandates.[8] Also, there was limited availability of high-quality training programs, with many currently used instructional materials inaccurate and outdated, while in addition, the provision of staff release time to attend available programs was often problematic. In response to this need, in 1992 the Centers for Disease Control and Prevention (CDC) staff and others began work on a set of self-study modules addressing various TB topics for workers in the New York City Health Department who had no previous training or experience in TB. Recognizing the broader utility of these modules, CDC subsequently revised them for a nationwide distance learning audience.

Distance learning technology represents an important avenue for addressing both training program quality and access issues, because travel, leave time, and thus cost can generally be minimized through such approaches. Likewise, evaluations of well-designed distance learning programs indicate they can be every bit as effective as "face to face" classroom instruction.[9,10] Given these advantages and the significant number of workers who required fundamental training in TB control, a print-based self-study course enhanced by satellite conferences entitled "A Satellite Primer on Tuberculosis" was developed and offered to a national audience. This course was a collaborative effort of the University of Alabama at Birmingham (UAB) School of Public Health, the Alabama Department of Public Health (ADPH), and CDC through the Division of Tuberculosis Elimination (DTBE) and the Division of Media and Training Services (DMTS), with CDC funding provided through an Association of Schools of Public Health (ASPH)/CDC/Agency for Toxic Substances and Disease Registry (ATSDR) Cooperative Agreement grant.

The goal of the "Satellite Primer" was to strengthen on-the-job effectiveness of TB control personnel by efficiently providing fundamental instruction on TB transmission and pathogenesis, epidemiology, diagnosis, treatment, and infection control. The curriculum for the course was based on a five-module print-based self-study course developed and extensively field-tested by the CDC during 1994 and 1995. The goal of this project was to produce and broadcast a series of five interactive satellite conferences designed to enhance the self-study modules. A second goal was to evaluate the entire learning experience. Specific objectives were to (1) effectively market the course to the appropriate target audiences, (2) maximize the number of participants who successfully complete the course requirements, (3) evaluate the knowledge gained and its perceived applicability to jobs, and (4) assess the effectiveness of a distance learning approach in addressing this training need.

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Methodology

Project administration

Overall coordination was provided by the School of Public Health, with team leaders identified for the school, the ADPH, and the two CDC divisions. The majority of project activities were collaborative in nature, with primary oversight responsibility for components assigned according to the following structure (see Table 1).

All aspects of the project were carried out according to predetermined process objectives—both programmatic and technical—that involved specific milestones, designated responsible units, and time frames. Routine communication among the project partners was maintained primarily through weekly or biweekly conference calls and E-mail, with face-to-face meetings called as needed.

Marketing and enrollment

The marketing approach built upon established relationships between the CDC and the state distance learning coordinators (DLC), TB controllers, and a state coordinators network that was created for this project. Initially, a letter describing the project was sent to the DTBE consultants, who serve as the division's points of contact for the states, with a request for their assistance and support. Shortly thereafter, a letter was sent to all state TB controllers requesting that they participate in the project and name a state coordinator. Copies of this request were sent to the health officer, the DLC, and the public information officer in each state. A subsequent letter was sent to the designated state coordinator outlining program objectives and specific responsibilities. It was decided at the outset that course enrollment should be limited to 5,000 participants to ensure effective management by the states and provide adequate opportunities for participant interaction. Each state was given a suggested, negotiable enrollment allotment determined on the basis of the state's recent TB incidence. The state coordinators were also asked to estimate the number of individuals from their respective states who were likely to participate in the course. Finally, registration packets were sent to the coordinators for distribution to potential enrollees. These packets contained a marketing brochure, registration materials, a pretest, and a postage-paid return envelope.

The state coordinator assumed a critical role in the project, because this individual represented a key contact who was not only responsible for identifying course participants through TB program supervisors, but also for designating, training, and communicating with the state's downlink site facilitators. A designated site facilitator at each downlink location ensured that the physical facilities were prepared, equipment was operational, and any technical problems were appropriately addressed in a timely manner. In addition, the facilitator was encouraged to

Table 1

Division of project responsibilities for "A Satellite Primer on Tuberculosis"

Activity	SPH	ADPH	DTBE	DMTS
Project leadership, coordination	X			
Marketing design	X			
Site facilitator materials	X			
Evaluation	X		X	X
Satellite conference instructional design		X	X	X
Broadcast production		X		
Satellite conference faculty			X	X
Responses to participant questions		X	X	
Print-based instructional materials			X	X
Course enrollment and registration			X	X
State coordinator recruitment			X	
CEUs, certificates				X

stimulate questions and discussion amongst the participant group before and after the satellite broadcasts. The facilitator also collected participant evaluation forms after each session and administered the posttest at the conclusion of the fifth conference. Everyone who completed the course, including the posttest, received a certificate verifying their participation. Those scoring at least a 70 percent on the posttest received 2.8 continuing education units (CEUs). Given the pivotal responsibilities of the state coordinators, a conference call training session was scheduled for them on two separate occasions, with half participating in each session.

Particular target audiences for the course included outreach workers in health department TB, HIV/AIDS, and sexually transmitted disease programs, as well as workers in other settings serving persons at high risk for TB, such as those in correctional facilities and drug treatment centers. After receiving the completed registration form and the computer scannable pretest answer sheet, CDC mailed the registrant a set of self-study modules and satellite conference information. Once the registration period ended, CDC provided each state coordinator with a computer disk listing participants from the corresponding state, as well as a set of participant mailing labels. Letters were then sent by the state coordinators to participants in their states informing them of the downlink site they were to attend.

Instructional design

A core instructional team representing the ADPH, UAB, the Bureau of Tuberculosis Control of the New York City Department of Health, and the two CDC divisions developed the content for the conferences, including the graphics and preproduced video segments. In addition, one of the instructional team members from DTBE (W.W.) served as an on-camera course coordinator for all five conferences to provide continuity.

Course implementation

The following five satellite conferences, which corresponded to the five self-study modules, were scheduled at one- to two-week intervals in May and June of 1995:

1. Introduction to course, transmission, and pathogenesis of TB
2. Epidemiology of TB
3. Diagnosis of TB infection and TB disease
4. Treatment of TB infection and TB disease
5. Infectiousness and infection control

Each conference involved a review of the module topic by the faculty expert, who also participated in the development of the session content. The reviews focused on the most important information in the modules, clarification of difficult concepts, and enhancement of content with other media. They also incorporated a variety of brief exercises, case study examples, and interviews to reinforce the concepts presented. The conferences were interspersed with question/discussion segments in which participants from remote sites could interact with the topic expert. Both a toll-free telephone number and a fax number were available for this purpose, and experts remained available to respond to questions for one hour after the end of each satellite broadcast. Before the first conference, procedures were established for managing and responding to the various categories of conference questions, including technical assistance questions.

A total of 575 downlink sites were established in 47 states, the District of Columbia, and the Virgin Islands. Only one state declined to participate, although the limitations of the satellite "footprint" also precluded the inclusion of Alaska and Hawaii. The satellite conferences were broadcasted from the Coffee County Health Department in Enterprise, Alabama, which has a studio facility. The ADPH produced these programs with its Ku Band uplink/production truck, which is equipped for interactive satellite programming. The conferences were available on both C and Ku bands, and a satellite coordinate test period was established for the downlink sites.

Evaluation

The evaluation plan was designed to address the four outcome objectives as well as a variety of process measures that related to all aspects of the project. The plan was based in part on a process developed by CDC staff for measuring the success of distance learning programs, the Training Efficiency and Effectiveness Model.[11] This model focuses on meeting the needs of key stakeholders including students, faculty, instructional designers, media specialists, and administrators. Accordingly, a number of data collection instruments were administered at key points during the development and implementa-

tion of the "TB Primer." Descriptive data on course participants, including demographic and job-related characteristics were compiled, as were pre- and posttest scores. The significance of the change in pre- and posttest scores was assessed by determining confidence limits around the mean change using a statistical analysis system–based paired *t* test procedure. In addition, a written session evaluation on each satellite conference and an evaluation of the overall program were solicited from the participants. Finally, state coordinators and site facilitators were requested to complete evaluation questionnaires from the standpoint of their roles and responsibilities.

As an adjunct to the assessment of knowledge gain from pre- and posttest score comparisons, a sample of course participants, as well as a sample of those who did not take the posttest, were selected for questionnaire interview nine months after the course ended. This survey was intended to elicit feedback on: (1) the degree to which participants felt that knowledge gained from the course was in fact being applied on-the-job; (2) the extent to which the "Satellite Primer" had a positive impact on their job responsibilities; (3) reasons for noncompletion of the course; and (4) preferred methods of future training. The results of the follow-up evaluation will be presented in a separate paper.

Results

Participant characteristics

A total of 3,452 individuals from 47 states, the District of Columbia, and the Virgin Islands enrolled in the Satellite Primer course, with a mean of 70 (median 60) participants registered from each state/territory. Of this group, 2,359 (68.3%) completed the posttest (Figure 1). Comparisons of course completers and non-completers with respect to occupational characteristics and employer category are summarized in Tables 2 and 3, which indicate that over 70 percent of course completers classified themselves as nurses and over 70 percent as employees of state or local agencies, predominantly public health departments. Of the non-completers, over 60 percent were similarly in those occupational and employer categories. Forty-nine percent of the course complet-

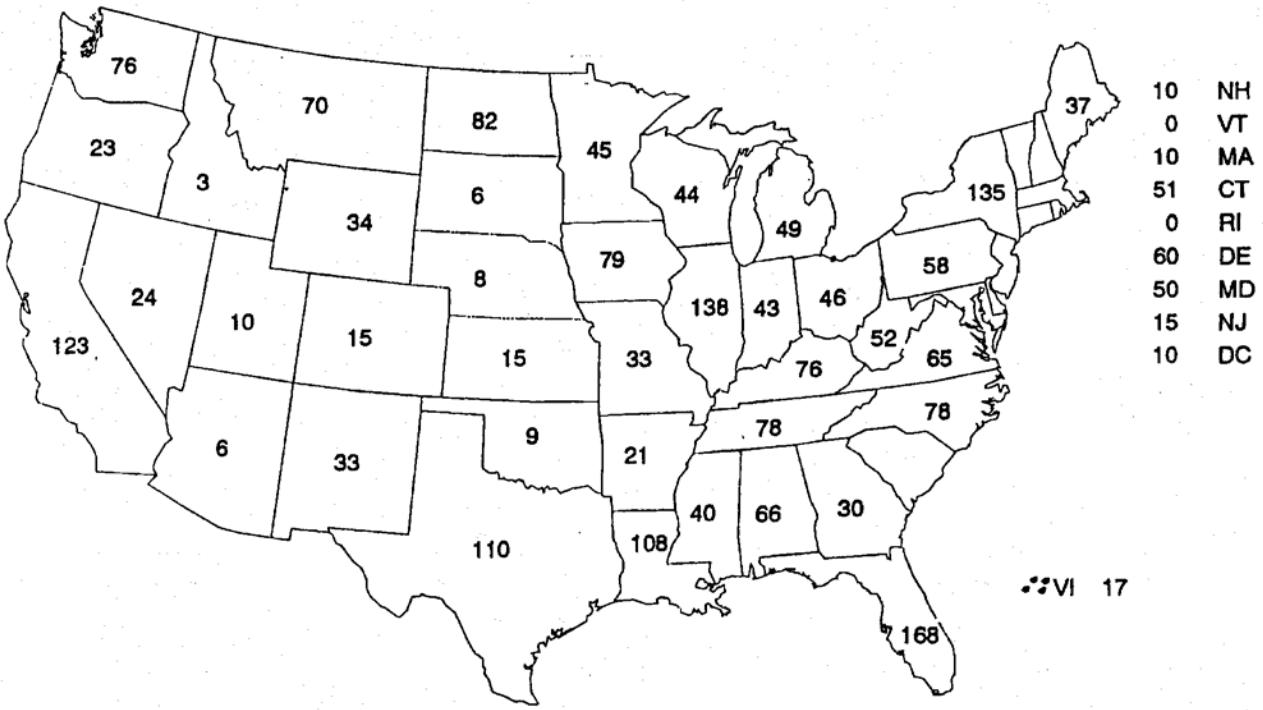

Figure 1. Satellite primer for TB participants reporting both pretest and posttest number and percent by state (N = 2,359).

Table 2

Participation in satellite primer on TB course by primary occupation

	Course completers		Course noncompleters		
Occupational category	**No.**	**%**	**No.**	**%**	**Attrition rate, %**
Nurse	1,686	71.5	698	64	29.3
Outreach worker	109	4.6	45	4	29.2
P.H. aide/assistant	47	2.0	24	2	33.8
Disease investigator	216	9.2	84	8	28.0
Allied health technician	33	1.4	17	2	34.0
Other	223	9.4	203	19	47.6
Not specified	45	1.9	22	2	32.8
Total	2,359	100.0	1,093	100.0	31.7

ers had received at least a bachelor's degree before enrolling in the Satellite Primer, with another 22 percent reporting an associate degree as their highest level of academic achievement. The previous TB experience of the completers varied widely. Although 22 percent had been working in TB programs less than six months before enrolling in the course, 40 percent reported over two years of relevant prior experience. Excluding the 47 percent course attrition rate for the "Other" occupational category, attrition by occupation was relatively consistent at approximately 30 percent, while course participants who were employees of state and local agencies were 30 percent less likely to drop out than those in the other employer categories. Another 2,500 individuals who did not meet the enrollment deadline were provided with the self-study modules and attended the satellite conferences as auditors. Descriptive data on this group were not obtained, although approximately half did submit course evaluation information.

Pretest/posttest performance

Mean pretest and posttest scores of all who completed the course were 80.8 percent and 91.8 percent respectively, a statistically significant increase ($p < 0.0001$), with only 52 (2.2%) of the 2,359 completers failing to score a grade of 70 percent or more on the posttest. Mean test scores by employer category and primary occupation are summarized in Tables 4 and 5, with the percent increase in score for each similarly significant. The posttest score increase was generally consistent across the specific occupational categories, although on average, nurses and disease investigators achieved somewhat higher scores on

Table 3

Participation in satellite primer on TB course by employer

	Course completers		Course noncompleters		
Employer category	**No.**	**%**	**No.**	**%**	**Attrition rate, %**
State/local agencies	1,693	71.8	657	60.1	28.0
Federal	45	1.9	30	2.7	40.0
Hospitals/clinics	385	16.3	249	22.8	39.3
Other	200	8.5	132	12.1	40.0
Unspecified	36	1.5	25	2.3	41.0
Total	2,359	100.0	1,093	100.0	31.7

Table 4

Comparison of mean pre- and posttest scores of satellite primer on TB course participants by occupational category

Occupational category	No.	%	Mean, pretest score	Mean, posttest score	%* increase
Nurse	1,686	71.5	82	93	13.4
Outreach worker	109	4.6	74	83	12.2
P.H. aide/assistant	47	2.0	75	84	12.0
Disease investigator	216	9.2	82	91	11.0
Allied health technician	33	1.4	78	89	14.1
Other	223	9.4	73	92	20.5
Not specified	45	1.9	77	92	19.5
Total	2,359	100.0	81	92	13.6

*$P < 0.0001$ for each category; paired difference t test.

both tests than did the other specific occupational groups. The variation in pre- and posttest scores was considerably less among the employer categories than among the primary occupational categories of participants. When completers were categorized by their length of prior TB experience (<12 months vs. >12 months), the performance of the less experienced individuals on both the pre- and posttest was significantly lower than that of experienced participants (Figure 2). Table 6 summarizes mean pretest scores of non-completers by occupational category, with these scores 2 to 15 points lower than comparable categories of completers. In contrast, when non-completers were categorized by employer, their mean pretest scores were virtually identical (Table 7).

Evaluation results

The vast majority (>88%) of those who completed the course felt the content of the written modules was appropriate, both in terms of technical level and amount of material. A similar proportion of this group believed that videotapes of the satellite conferences would be an important element in future offerings of the course. When asked to indicate the extent to which they agreed with statements beginning with the phrase "I am confident I could..." in relation to each of the five basic components of the course, approximately 80 percent agreed or strongly agreed with the statements for each component. In other words, completers not only reached a high level of

Table 5

Mean pre- and posttest scores (%) of satellite primer on TB course participants by employer category

Employer category	No.	%	Mean, pretest score	Mean, posttest score	%* change
State/local agencies	1,693	71.8	82	92	12.21
Federal	45	1.9	78	91	16.7
Hospitals/clinics	385	16.3	81	92	13.6
Other	200	8.5	76	91	19.7
Unspecified	36	1.5	80	89	11.2
Total	2,359	100.0	81	92	13.6

*$P < 0.0001$ for each category; paired difference t test.

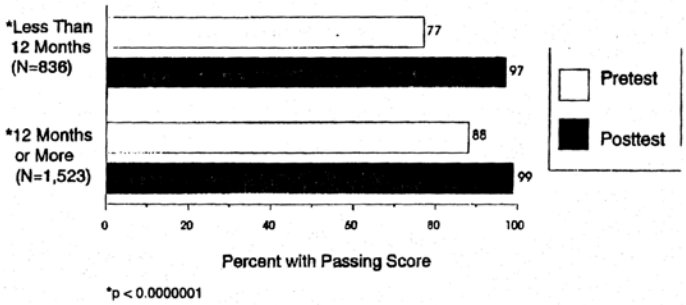

Figure 2. Percentage of participants who passed the pretest and posttest by length of TB experience ($N = 2,359$).

subject matter mastery, they felt more confident that they could apply that knowledge. The gain in confidence attributed to each course component by completers was statistically significant for all but the "Epidemiology" segment (Figure 3).

With respect to participant satisfaction, more than 80 percent of the completers agreed or strongly agreed that the course was worth the time and effort it required and that they would recommend it to colleagues. Eighteen percent neither agreed or disagreed, and less than 2 percent disagreed with these statements. Most also felt that direct access to the faculty during and after the satellite sessions was a valuable feature of the course, as was the availability of a well-informed site facilitator for each session. A majority of the completers also felt the amount of time allotted to work through the modules, about 7 weeks, was appropriate. Finally, the distribution of downlink sites appeared to be satisfactory, based on evaluation feedback. Eighty-three percent of the course completers traveled less than 50 miles to a site, and 77 percent of the participants felt the distance they traveled was not excessive. Those who audited the course and submitted evaluations were even more positive about the course than were the course completers, with 89 percent feeling it was worth the time and effort and 85 percent willing to recommend it to colleagues.

Discussion

The 1991 report to Congress on health personnel estimated that there were approximately 500,000 individuals in the nation's public health workforce, with over half having no professional training in public health.[12] At the same time, the scope of public health has expanded significantly since the turn of the century, when control of infectious diseases represented the primary focus of public health efforts. Today, a myriad of noninfectious and behaviorally related conditions are also included under the public health rubric, although a number of historically important infectious diseases, including TB, continue to pose significant public health challenges in the United States. This evolution of public health, both in terms of its breadth and its scientific base, has added an important dimension to the workforce need for high quality educational programs. Given budgetary and other resource constraints of agencies and organizations charged with providing community public health services, various distance learning

Table 6

Mean pretest scores of satellite primer on TB course noncompleters by occupational category

	Noncompleters		
Occupational category	**No.**	**%**	**Mean pretest score**
Nurse	698	63.8	80
Outreach worker	45	4.1	65
P.H. aide/assistant	24	2.2	73
Disease investigator	84	7.7	78
Allied health technician	17	1.6	72
Other	203	18.6	70
Not specified	22	2.0	62
Total	1,093	100.0	77

Table 7

Mean pretest scores of satellite primer on TB course noncompleters by employee category

Employer category	No.	%	Mean pretest score
State/local agencies	657	60.1	77
Federal	30	2.7	77
Hospitals/clinics	249	22.8	77
Other	132	12.1	77
Unspecified	25	2.3	76
Total	1,093	100.0	77

approaches to meeting these training needs are becoming increasingly common alternatives to traditional "live" classroom instruction. Toward this end, the CDC, in collaboration with academic institutions and state and local public health agencies, has taken a lead role in enhancing the access of large numbers of personnel to distance-based educational programs. The Satellite Primer on Tuberculosis is the result of such a collaboration that additionally involved participation of a large number of individuals at the local level within each state and territory to ensure effective delivery of the course. The strategy was to develop a network that would allow promotion and ultimately acceptance of the program from the highest administrative levels to the level of the target audiences. With respect to the course format, it was felt that the satellite conferences enhanced the print-based modules in the following ways:

- Allowed transmission of consistent information to thousands of course participants
- Provided immediate feedback from expert faculty in response to participant questions
- Provided an opportunity to emphasize important elements of the modules
- Enabled faculty to clarify difficult concepts
- Facilitated instruction for participants with various learning styles through the use of video and other application-related enhancements
- Resulted in videotapes for use with the self-study modules as a training resource

It was not possible to determine from the post-course evaluation data whether the satellite conferences increased learning beyond what might be achieved with the print-based materials alone. Nonetheless, course participants indicated overwhelmingly that the conferences amplified the learning experience and hopefully enhanced the likelihood of course completion.

The primary target audience for the course was entry-level TB workers; essentially those individuals with little or no training or experience in providing TB-related services. In actuality, however, 1,523 (64%) participants who completed the course had more than 12 months of experience, and about the same proportion were nurses. Possible reasons for this include (1) a limited number of entry-level TB workers, (2) a failure to identify or enroll entry-level workers, or (3) experienced TB workers were not confident about their basic TB knowledge. Given this diversity of backgrounds, it is perhaps understandable that the pretest scores of both those who completed the course and those who did not complete it were relatively high. It is also worth noting that the knowledge gain as determined by pretest/posttest

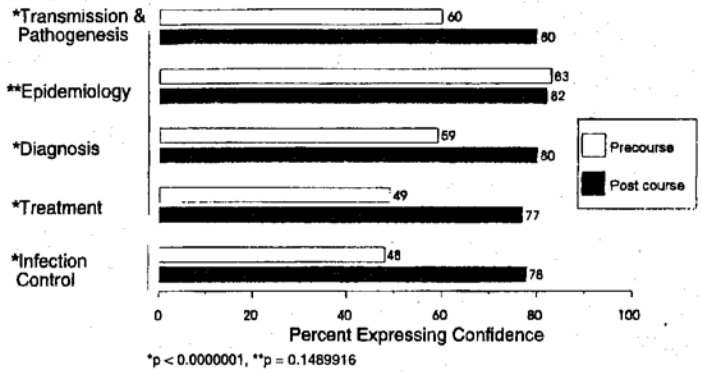

Figure 3. Percentage of course completers expressing confidence in knowledge of TB by subject ($N = 2,359$).

score comparisons was fairly consistent across specific occupational categories (i.e., 11–14% gain), regardless of the performance level on the pretest. In retrospect, it was felt that clinical backgrounds and TB program experience should not be exclusionary criteria for enrollment in the course, given the inconsistent relationship that was demonstrated between clinical credentials or time on the job and the level of basic knowledge of TB. Nevertheless, those with less than one year of TB-related experience who completed the course did exhibit a greater increase in test scores and in perceived confidence in applying course-related knowledge than did completers with more than one year of experience.

■ ■ ■

The print-based self-study course continues to be offered by the CDC, with 1.8 CEUs awarded for successful completion of the course and the posttest. Multiple sets of the satellite conference videotapes were distributed to the state coordinators, along with information on how to order additional sets of the modules and videotapes. In 1996, the "Satellite Primer" and the self-study modules received an Award for Excellence from the International Society for Performance Improvement. The ultimate measure of success, however, will be the extent to which knowledge gained from the course is applied in the workplace. As noted, evaluation data obtained from course participants at the conclusion of the course, while highly complimentary on the content and delivery, did not permit an assessment of applicability of the course content to job responsibilities, although the follow-up survey is intended to provide such insight. However, the knowledge gain based on pre- and posttest scores and the positive response to the course format do represent bases for decisions on future training program approaches.

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