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Capacity building of biodefense informatics for public health preparedness and response in rural regions: EpiInfo, GIS, and data management training

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Capacity building of biodefense informatics for public health preparedness and response in rural regions: EpiInfo, GIS, and data management training

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ABSTRACT

Introduction: Emergency informatics such as data management and geographic information systems applications have become an important training agenda for enhancing health surveillance and risk communication in public health emergencies. The free EpiInfo/EpiMap software developed by the CDC offering domain knowledge such as health information management may be particularly useful for preparing nonurban jurisdictions often confronting limited resources in dealing with health emergency events. This article describes the delivery of training workshops to enhance the competencies of health workers in biodefense informatics and discusses its implication for delivering education to rural regions.

Methods: Three EpiInfo/EpiMap workshops entitled "Biodefense Informatics and Health Surveillance Database Management" were delivered to public health practitioners of rural Texas. Each workshop covered three modules: tabletop exercises, EpiInfo, and EpiMap hands-on training. A web-based training modality was developed to supplement classroom sessions. Training manuals and a CD-ROM were distributed to trainees. Pretests and posttests were administered to evaluate the workshop effectiveness, and descriptive statistics of the results was summarized.

Results: Forty regional or local health department staff attended the workshops. The pretesting and posttesting indicated that participants enhanced competencies and skills in biodefense informatics and data management. Self-reported evaluation indicated

that knowledge increased upon completion of the training. The majority (97 percent) of the participants found the workshops relevant and useful, and many noted that the courses enhance their preparedness efforts.

Discussion: These results support the need of continuing biodefense informatics training for nonurban public health practitioners and provide directions for developing training programs in health preparedness informatics.

Key words: emergency preparedness and response, biodefense informatics, epidemiology, GIS

INTRODUCTION

Health informatics relates to the collection, analysis, and reporting of health data for the protection of public health. Informatics and risk communication are important aspects of emergency preparedness and response, and they constitute key competencies for public health workers for disaster readiness.¹ Several informatics applications have been developed in the public domain to encourage the application of informatics in public health practice. Among many useful tools, EpiInfo software and its Geographic Information Systems' (GIS) component EpiMap were made available by the Centers for Disease Control and Prevention (<http://www.cdc.gov/epiinfo>). These programs have been field tested and found to be very useful for communicating risks, for example, in the recent anthrax attack investigation in New Jersey.² In particular, GIS was instrumental in the development of a syndromic surveillance system in New York City,³ in

the implementation of state-wide public health surveillance systems in the states of Utah⁴ and New York,⁵ and in the promotion of medical situational awareness and surveillance of potential influenza epidemics in the US military.⁶ In light of the proven utility, availability, and ease of installation and use of the EpiInfo program, the Texas Department of State Health Services supported the development of these biodefense training modules that included both EpiInfo and GIS to enhance the preparedness and response capabilities of local public health practitioners.

The primary purpose of this article is to present the content, delivery, and evaluation results of training workshops, which were conducted to enhance the competencies of rural (public) health workers in biodefense informatics and database management. The modules were developed based on several recommended guidelines for preparedness competencies. These included the CDC guidelines, "Preparedness Planning and Readiness Assessment and Public Information and Communication,"⁷ and the "Core Public Health Worker Competencies for Emergency Preparedness and Response" developed by Columbia University School of Nursing.⁸

With regard to the delivery of biodefense-related training, several studies of healthcare providers (including previous studies by this research team)⁹⁻¹¹ suggested that most providers preferred tabletop, hands-on courses, web-based curricula,¹² or interactive CME courses.¹³ Others found that screensavers and web sites can be used to enhance bioterrorism awareness, and web-based education may provide an effective means of bioterrorism education to an audience of health providers.¹⁴ These research findings guided the development of our training modality and modules.

METHODS

The Texas Department of Health sponsored three informatics workshops to enhance the informatics competencies of public health workers in 37 counties in Texas Public Health Regions 2 and 3 served by the Arlington Regional Office of the Texas Department of Health. The workshops were conducted from September 2003 to May 2004. Most of these counties were classified as rural, "non-participating" counties,

meaning that they did not have a local health department. The training modules consisted of three components: tabletop exercises, EpiInfo, and EpiMap hands-on training modules. See Appendix 1 for training brochure that describes the training modules. Tabletop exercises included simulated bioterrorism attack scenarios and the use of data sources including census data. EpiInfo and EpiMap components included tabulating and mapping data relevant to emergency management and risk communication. More than 30 public health workers attended the workshops. Qualitative analysis was applied to analyze the data, and aggregated results are reported.

Preworkshop assessment

A preworkshop and a postworkshop evaluation design was implemented. The investigators/facilitators, in collaboration with the Texas Department of Health staff, developed an assessment instrument. The pretest survey questionnaire was implemented prior to the training. The purpose of the pretest was to a) collect baseline data regarding participants' knowledge, skills, and previous risk communication training; and b) refine the content of the training modules to fit the needs of the participants.

The instrument included two sections. The first section included eight items regarding respondents' perceived computer application-based competencies. Participants were asked to rate their perceived knowledge using a Likert-type scale from one ("not knowledgeable") to five ("very knowledgeable"). Questions are included in Figure 1. The second section included eight multiple-choice items, which measured the participants' actual knowledge on EpiInfo and EpiMap, as well as general knowledge on database management and disease mapping. Responses one and two on the Likert scale were recoded as the not knowledgeable category and responses three to five as the knowledgeable category. At the conclusion of the workshop, participants were asked to complete a postworkshop assessment, which was identical to the preworkshop assessment.

After the first workshop, which served as a pilot test for the instrument, several changes were made to the second section of the questionnaire to better

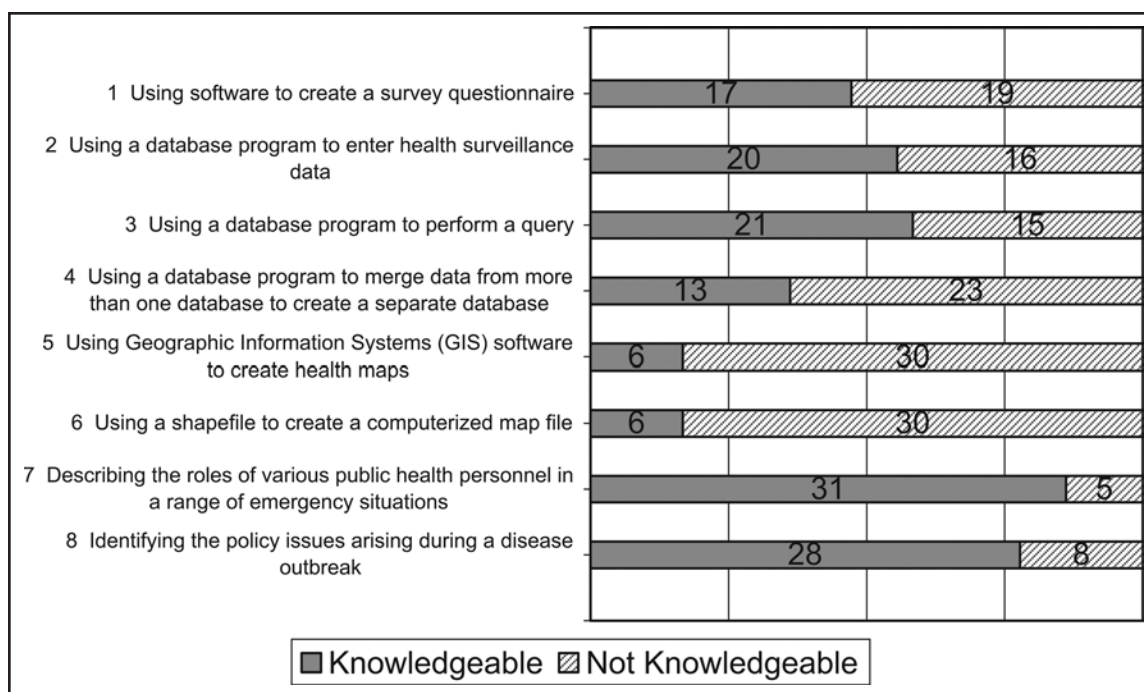


Figure 1. Preworkshop perceived knowledge results.

address areas that were particularly weak among the participants. Therefore, the scores obtained from the first workshop were not included in the final analysis.

In administering the assessment and evaluation, all research ethics principles outlined in the Declaration of Helsinki were followed. The results were qualitatively analyzed and aggregately reported.

RESULTS

A few participants did not complete both tests (or either test). A total of 33 preworkshop assessments and 33 postworkshop questionnaires were successfully completed and included in the analysis. Figure 1 shows that participants expressed a need for increased knowledge in most of the competency areas addressed by the EpiInfo Data Management Training and GIS. In four of these areas fewer than 50 percent of participants rated themselves as knowledgeable.

Eighty-three percent of the participants responded that they were not knowledgeable in creating maps using GIS applications or in using shapefiles to create maps, and 64 percent believed that they were not knowledgeable in merging databases. In addition,

about half of the participants were not knowledgeable in the areas of creating questionnaires, entering surveillance data, or performing queries in a database. The average correct score from the knowledge-based section was 50 percent.

Postworkshop assessment

Thirty-three postworkshop questionnaires were analyzed. Because some participants had to leave early or did not fully complete their questionnaires, averages for comparison purposes were calculated from 26 preworkshop assessments and 21 postworkshop assessments that were successfully completed. Mean scores increased in both the perceived and actual knowledge-based sections of the questionnaire. Figure 2 presents the pretest and posttest results for section one: perceived knowledge. The average correct score increased from 50 percent to 62.5 percent.

In the postassessment, all participants responded that they believed themselves to be more knowledgeable in creating questionnaires and entering surveillance data. Moreover, 90 percent of the participants responded that they were knowledgeable in performing

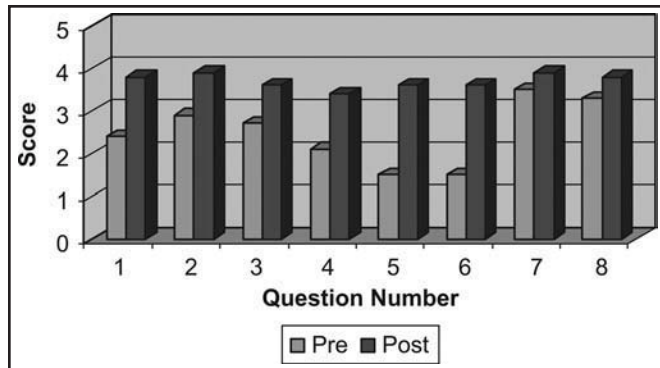


Figure 2. Comparison of preassessment and postassessment perceived knowledge scores.

queries, merging databases, creating maps, using GIS shapefiles, and identifying policy issues in outbreak situations. One-hundred percent of respondents reported that they were knowledgeable in describing the roles of public health professionals in an emergency.

COURSE EVALUATION

Figure 3 presents responses from 36 course evaluation questionnaires completed and analyzed for the three workshops.

Questions 9 through 12 of the course evaluations solicited written feedback and comments from participants. The responses were grouped into categories, and the results are presented in Figure 4.

Responses to Question 9 (“Which segment of the workshop was most useful to you?”) indicated that 12 respondents (33 percent) found EpiInfo training to be the most useful segment of the curriculum. Eight respondents (22 percent) reported that all aspects of training were helpful, and seven respondents (19 percent) found the EpiMap training to be the most useful. Additionally, eight respondents (22 percent) found that “staff assistance” and “hands-on exercises” were helpful. Several respondents commented that having extra staff members to assist with individual participant’s concerns and the hands-on nature of the training were helpful (Figure 4).

The majority of responses to Question 10 (“Which segment was least useful to you?”) were placed in the “none” category. However, many other responses to this open-ended question were classified as “other.” The written responses included the description of GIS

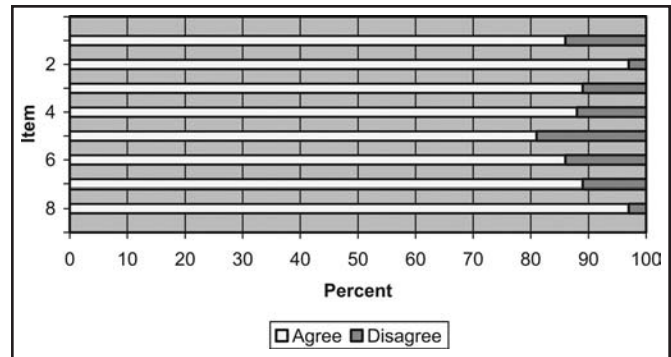


Figure 3. Course evaluation ratings. Course evaluation questions: (1) The training room and setup was comfortable and conducive to learning. (2) The use and function of Epi-Info and Epi-map in public health are relevant and address my needs regarding the topics of health surveillance and bioterrorism response. (3) The amount of material provided for the workshop was appropriate. (4) The scenario was clearly described and appropriate for the scope of the training. (5) Workshop presenters presented the information in a clear and logical manner. (6) Workshop presenters used effective teaching strategies. (7) Workshop presenters demonstrated mastery of the topics. (8) Workshop presenters used visuals and handouts that contributed to the session.

theory (one response), software problems (one response), summary (one response), the tabletop exercise (one response), and that the duration of the workshop was too long for the material covered (one response). (Figure 4).

In response to Question 11 (“What additional topics in the area of database management and health surveillance analysis would help you in your present job?”) participants commented that they would benefit from more training in merging databases and from having more exercises using EpiInfo and EpiMap. “Other” responses (three comments) included a comment on field inspection systems, additional mapping applications/capabilities, and more statistical analysis (Figure 4).

Responses to Question 12 (“Additional Comments”) suggested areas in which the workshop could be improved. It should be noted that the majority of these responses came from evaluations of the first workshop. These suggestions were noted and addressed in subsequent workshops. Two responses suggested that the tabletop exercise might include exercises

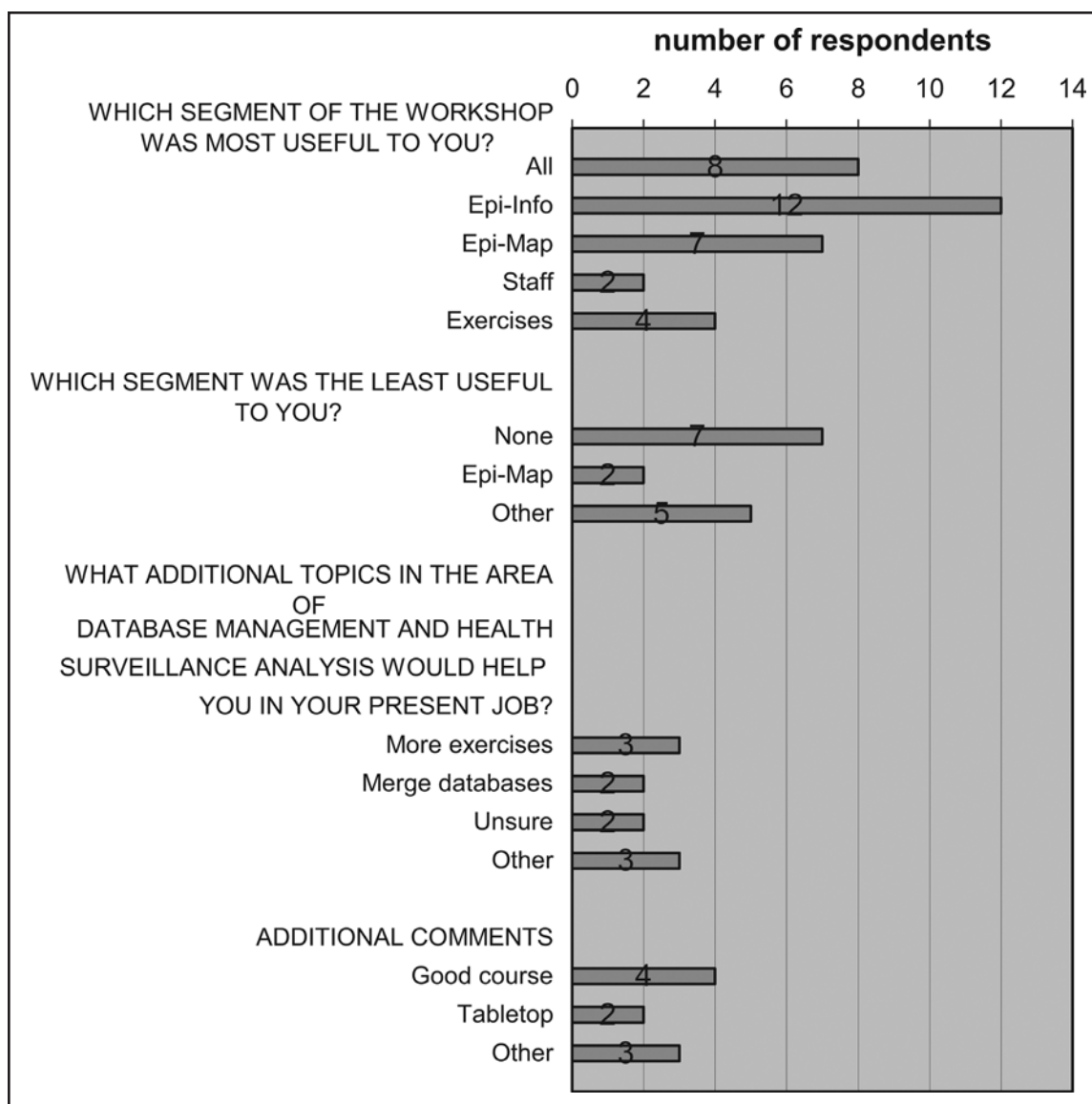


Figure 4. Course evaluation comments.

using EpiInfo and EpiMap. Four responses commented that the workshop was a good course and well instructed. One response suggested that there should be a basic computer literacy competencies prerequisite for the workshop (Figure 4).

DISCUSSION

Consistent with the literature¹³ and our previous studies of physicians and physician assistants,⁹⁻¹¹ the results of the present study suggest that most public health workers preferred either self-paced training or workshops of tabletop, hands-on type courses, and

interactive CME courses, versus large-classroom, formally structured lectures. In addition, future modules on preparedness may reflect the lessons learned from the study. These include the need for individualized one-on-one instruction, as participants represented a wide variety of knowledge and skill levels and professional backgrounds. The web-based registration system proved to be effective in collecting participant's information. The community colleges where the workshops were offered provided well-equipped computer labs suitable for the training, and it appeared that community colleges in general afford

ideal locations for community-based training in rural counties. The training room setup, which included two projectors and two screens, facilitated the Powerpoint presentation on one screen while participants completed related exercises shown on the other screen. A fully equipped mobile classroom may facilitate the training of local public health workers across a state.

Ninety-seven percent of workshop participants found these Biodefense Informatics and Health Surveillance Database Management Training workshops to be relevant and useful. Self-assessed knowledge increased in all evaluated areas as a result of the training. Many participants gave comments in the postworkshop evaluations such as “Good teaching” and “Will apply to my job.” As discussed earlier, EpiInfo and EpiMap have a number of capabilities that can aid health professionals in the quick and convenient analysis of health data, and GIS has been found conceptually and empirically useful in disaster preparedness^{1,9-11} and response.^{15,16} Some participants noted a need for more application exercises and advanced mapping or statistical analysis. An advanced version of the workshop could be developed and offered to those already familiar with the basic functions of EpiInfo and EpiMap. Additional areas for consideration may include training modules on exposure and response to toxic substances, statistical analysis and interpretation of data, epidemiology, and cluster analysis that were used in the studies of rural/urban disparities in public health emergency preparedness.¹⁷

To cover the core competencies of biodefense informatics, the curriculum would take almost 2.5 days for the delivery of the entire modules. We found that the curriculum can be shortened (to about 2 days) to focus on core competencies of preparedness. A few participants had to leave the workshops early due to time-sensitive job assignments. Feedback from these workshops has suggested that 2 days of actual classroom sessions might be a practical time limit for participants. More than 2 days will be difficult for some to commit to receiving training, given the traveling across several counties for some workshop attendees and the limited availability of time away from their usual public health work duties. Lastly, although the pretests

and posttests given in this study were useful indicators of the short-term impact of the workshops, assessing the long-term impact of the workshops is very important for evaluating the effectiveness of the training. It should be further evaluated with follow-up studies to be conducted among these training participants.

STUDY LIMITATIONS

The ability to extrapolate the results of this biodefense informatics training study is constrained by its limitation to public health workers in the nonurban settings of Texas counties. It is not known if potentially participating public health workers in urban settings have similar baseline levels of knowledge in biodefense informatics and data management.

CONCLUSION

The results confirmed that participants preferred self-paced training or workshops of tabletop, hands-on type courses, and interactive CME courses, versus large-classroom, formally structured lectures. In addition, future preparedness modules may reflect the lessons learned from the study. These include the need for individualized one-on-one instruction, as participants included a wide variety of knowledge levels and backgrounds. The results also provide support for the observations that local health workers lack prior exposure to biodefense informatics and data management training, as evidenced by the results of the pretests and posttests demonstrating the improvement in knowledge of, and skills in, the workshop training topics. More tailored training should be delivered to address these needs.

LESSONS FOR PRACTICE

- There is a need for the training of rural public health workers in bioinformatics/ data management for emergency preparedness and bioterrorism response.
- Workshop participants increased their knowledge from the training as measured by subjective and objective self-assessments, and found it relevant and useful to their jobs.

- Participants prefer tabletop, hands-on type courses, or interactive CME courses versus large-classroom, formally structured lectures. This is consistent with the findings of our survey of physicians and physician assistants in rural areas of Texas.
- Workshop participants benefit from teaching assistants to help with one-on-one instruction.
- Community colleges provide an excellent venue for conducting computer-based training courses for healthcare workers in rural areas.

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Appendix

TRAINING SCHEDULE

DAY 1

Introduction and overview to Epi
Info and Epi Map; presentation of
scenario

Creating a data collection
questionnaire, data entry, and
checking code

DAY 2

Basic and intermediate database
management and analysis, and
read/write other databases into
Epi Info

Cleaning up databases, Introduction
to relational databases, Epi Map,
and basic spatial analysis

DAY 3

Recap of Days 1 and 2 and
Review of Major Concepts

Table Top exercise

Evaluation

*This training workshop will be
presented by the following faculty of
the University of North Texas Health
Science Center School of Public Health*

Chiehwen Ed Hsu, PhD, MPH, MS
Health Management and Policy

Terry Gratton, DrPH
Occupational and Environmental Sciences

Sejong Bae, PhD
Biostatistics

Sandi Cleveland
Community Health

Emeka Ohagi
Health Informatics

Ella T. Nkhoma
Epidemiology

Rami Hamarna
Health Management and Policy

Brian Wittenmyer
Health Management and Policy

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**BIODEFFENSE
INFORMATICS
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SURVEILLANCE
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TRAINING**



**March 31 – April 2, 2004 &
May 26 – May 28, 2004**

**TDH Regions 2 & 3
Arlington Headquarters
1301 S. Bowen Rd.,
Suite 200, Arlington, TX 76013**

Time: 9:00 am to 3:00 pm.

Prepared for Texas Department of Health Region 2/3

OVERVIEW

Informatics and database management are indispensable tools in the effort to prepare for the management of a potential bioterrorism event. GIS can facilitate the collection, integration, and presentation of population-based data, including data on possible exposures, risk factors, and the socioenvironment.

The purpose of this workshop is to provide public health professionals with health data tools that augment health surveillance, thereby improving public health disaster preparedness. The CDC has produced valuable integrated tools to aid in surveillance. This workshop will introduce participants to Epi Info and Epi Map use in a bioterrorist event.

TOPICS COVERED

During the three-day workshop, participants will learn to employ Epi Info and Epi Map software to perform a variety of surveillance activities. These activities include:

- questionnaire development

- data entry
- data management
- data analysis
- graphic/visual representation of data
- table top exercise

Epi Info

Participants will gain the skills in Epi Info to perform a wide range of epidemiological and health surveillance activities.

Participants will:

- Perform the steps of a field investigation of an outbreak.
- Create data collection questionnaires and select variables.
- Discover how Epi Info can facilitate data collection by setting properties of variables and checking code.
- Enter data, navigate programs and records, and use search/find functions to locate data.

- Use the basic analytical features of Epi Info to perform basic and intermediate analyses (ie frequencies, tables, and means).

- Learn essential surveillance concepts, such as odds ratios and relative risks.

- Facilitate analysis by creating code to perform computations and enforce conditions.
- Learn to open, read, and write other file formats into Epi Info.

Epi Map

Health surveillance benefits from the graphical representation of data provided by mapping systems.

Participants will learn the basic concepts of creating maps from Epi Info data. These concepts include learning to:

- Create line and polygon maps.
- Customize each map layer.
- Conduct spatial scan analysis of health surveillance.
- Save these as map files.

Participants will practice the practical application of these skills by learning to:

- Create a thematic map using Texas county health data.
- Create case-based maps.

OUTBREAK SCENARIO/TABLETOP EXERCISE

Participants will learn Epi Info and Epi Map by completing exercises using a foodborne outbreak scenario that will become a table top exercise.