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Assessment of Training Needs and Preferences for Geographic Information Systems (GIS) Mapping in State Comprehensive Cancer-Control Programs

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Geographic information systems (GIS) mapping technologies have potential to advance public health promotion by mapping regional differences in attributes (e.g., disease burden, environmental exposures, access to health care services) to suggest priorities for public health interventions. Training in GIS for comprehensive cancer control (CCC) has been overlooked. State CCC programs' GIS training needs were assessed by interviewing 49 state CCC directors. A majority perceived a need for GIS training, slightly more than half of state CCC programs had access to geocoded data, and the majority of programs did not require continuing education credits of their staff. CCC directors perceived judging maps and realizing their limitations as important skills and identified epidemiologists, CCC staff, public health officials, policy makers, and cancer coalition members as training audiences. They preferred in-class training sessions that last a few hours to a day. Lessons learned are shared to develop training programs with translatable GIS skills for CCC.

Keywords: *training; comprehensive cancer control; geographic information systems; mapping; health promotion; adult learning*

Public health promotion efforts continue to improve, as do the technologies that support these efforts. One technology, geographic information systems

(GIS), has great potential to facilitate health promotion and disease-prevention efforts by graphically identifying areas with the highest disease incidence or mortality to suggest priorities for health promotion practice. Spatially and temporally depicting multivariate relationships, GIS can uncover patterns between complex diseases like cancer and other factors such as health care service availability and behavioral and environmental risks that may not be readily apparent in other forms of analysis (Riner, Cunningham, & Johnson, 2004). For state comprehensive cancer control (CCC) programs, GIS can facilitate public health professionals' efforts to regionally assess the impact of cancer incidence or mortality and prioritize interventions. Translating GIS maps into effective public health actions will be critical to health practitioners' repertoire of skills.

CCC aims to "reduce cancer incidence, morbidity, and mortality through prevention, early detection, treatment, rehabilitation, and palliation" (Abed et al., 2000, p. 6). Use of GIS and mapping may advance these aims, as illustrated in California. Women at greatest risk of developing breast cancer were defined by geographic service areas using zip codes. Applying the National Cancer Institute's consumer health profiles narrowed the geographic units, and three target groups were identified for promotion activities, contributing to screening more than double the county's goal (Lubenow & Tolson, 2001). GIS technology is increasingly available to public health practitioners whose formal education has rarely included geographic (i.e., GIS) analysis of health data (Cromley & McLafferty, 2002; Riner et al., 2004). Training is needed to support practitioner skills to effectively utilize GIS and understand its benefits and limitations. A learner-centered GIS training framework, which begins with what

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intended audiences know about a topic, guided interviews with state CCC directors to assess GIS training needs and develop guidelines from lessons learned.

► BACKGROUND

The intent of interviewing CCC directors with respect to training was to develop an awareness of training needs to improve the competencies of public health professionals in the area of GIS and furnish them with practical skills. GIS is an education, research, and planning tool that allows discrete layers of data about places, events, phenomena, and populations to be separated into layers, then overlaid and recombined to yield new information not readily apparent from original data (Goldman & Schmalz, 2000). The increased use of GIS for health promotion practice may facilitate decisions about where to concentrate limited resources (Goldman & Schmalz, 2000). To realize this potential, CCC practitioners need to learn for which cancer-control planning and assessment questions GIS would be most useful.

Many public health practitioners, including CCC staff, lack experience in the application and use of GIS for disease prevention and control efforts (Short, Carlin, & Bushhouse, 2002). In addition, mapping technologies have moved forward with little consideration of whether CCC planners are able to judge the validity and reliability of maps they might use for cancer-control decision making (Crampton, 1995; Cromley & McLafferty, 2002). In recognition of this gap, the North American Association of Central Cancer Registries (NAACCR, 2005a) issued a recommendation outlining a need for GIS training and the importance of trained staff, which requires resources for continuing education (CE). This recommendation does not provide guidance on how to accomplish training nor the intended training audiences' expectations. Furthermore, the one previous survey that has investigated GIS training needs (NAACCR, 2005b) assessed cancer registry staff, an audience that tends to have quantitative training, which is frequently different than CCC planners, whose daily tasks involve the translation of evidence and policy into action. We did not find guidelines for GIS training for CCC programs in the literature.

Regardless of the situation, a favorable environment for training includes a perceived need to learn the skills, organizational support, and resources to apply what is learned (Noe, 1986). Learning is most likely to occur when those being trained and their leadership have a positive attitude toward the subject matter (Knowles, 1980; Vroom, 1995). Adopting new technologies such as GIS requires significant resources in the form of personnel and time spent learning new skills but also a fundamental change in the way daily tasks and problems are approached, understood, and accomplished. The support of senior leadership and stakeholders is critical to making the time and providing the resources (e.g., equipment, monetary support, and technology) needed to implement what is learned in training (Miranda et al., 2005). When trainees have an opportunity to use and apply the skills they have learned in training, their skills improve (Noe, 1986; Saleh, Williams, & Balougan, 2004).

A systematic needs assessment that evaluates the needed skills, audiences, goals, and appropriate training methods and formats substantially improves the effectiveness of training programs (Goldstein & Ford, 2002; Sleezer, 1993; Zemke, 1994). Despite the importance of needs assessments, few studies report conducting them prior to developing and evaluating training (Arthur, Bennett, Edens, & Bell, 2003). Furthermore, a needs assessment can lead to training that facilitates practitioners' efficacy relating to their ability to use GIS technology

(self-efficacy) and their belief in GIS as an effective strategy for CCC activities (response efficacy) (Bandura, 1997). Finally, a needs assessment evaluates the feasibility of preferred training methods. One common method of training public health practitioners on current science and technology is through CE. This survey of CCC directors thus examines the CCC organizational environment for GIS training, including readiness in terms of having access to cancer registry geocoded data, and assesses perceived knowledge and skills needed to use GIS and views about stakeholders' opinions of GIS mapping for CCC activities.

► METHOD

Participants

To assess GIS training needs of CCC programs, directors responsible for leading state CCC plans from 49 states (Louisiana was unavailable because of Hurricane Katrina) were interviewed via telephone. This research is part of a larger omnibus study to assess diffusion of GIS mapping technology in state CCC programs. Of the interviews, 42 were conducted with 1 interviewee (5 males, 37 females), and 7 were simultaneously carried out with groups of 2 or more participants (a total of 58 respondents in 49 interviews). Of the participants directly responsible for CCC plans ($N = 49$), nearly half had held the position for 2 years or less. Experience ranged from 1 month to 12 years ($M = 33$ months); half of the participants had worked in public health for more than 4 years ($M = 12$ years). Participants' formal education varied most, with 59.18% ($n = 29$) having a master's degree. Master's degrees ranged in specialty, including education, public health, social work, public administration, and business administration. Of interviewees, 16.0% ($n = 8$) had bachelor's degrees, closely followed by 12.24% ($n = 6$) having PhDs, 8.16% ($n = 4$) having MDs, 2.0% ($n = 1$) having an associate's degree, and 2.0% ($n = 1$) having an education as a radiation therapist.

Procedures

Interview guide. An interview guide was developed to assess program directors' experiences and perceptions relating to GIS and CCC, including their perceptions of training needs and preferences. Training questions addressed whether (a) CCC staff were required to participate in annual CE hours, (b) what approximate period would be appropriate for training, (c) what methods or format CCC staff would find most useful for training on the use of cancer maps, (d) perceived user skills for GIS, (e) what groups of audiences were seen as most appropriate

for training on GIS for CCC, (f) what training goals were preferred by CCC audiences, and (g) as a measure of organizational capacity, whether CCC programs' cancer registries geocoded their cancer data. A question about participants' preferences for training goals was added after the 20th interview ($n = 29$ for this question).

Recruitment. CCC program director names were initially identified from a spring 2005 CCC director list. E-mail was used to make initial contact with individuals. All states were included, with the exception of Louisiana, whose department of health was out of operation as a result of Hurricane Katrina during the time of interviews.

Data collection. A trained, female interviewer conducted the 30-min telephone interviews in English from July 14, 2005, to January 27, 2006. Prior to beginning the interview, the interviewer obtained verbal consent to conduct and taperecord the interview. Participants were also assured that no personally identifiable information would be included in analyses or manuscripts. The survey study was approved by the Pennsylvania State University Institutional Review Board.

Data Coding and Analysis

The interviewer transcribed the 49 interviews verbatim from the audio recordings. The transcripts were provided to the interviewees, who reviewed the transcripts for accuracy. Of transcripts, 72.0% ($n = 35$) were returned as validated by interviewees, whereas 28.57% ($n = 14$) of interviews were not. Of the 35 participants who returned their validated transcripts, 42.86% ($n = 15$) added comments. The final transcribed interviews averaged 4.43 single-spaced pages ($SD = 1.12$), totaling 217 pages of single-spaced, typed verbal data.

To capture the scope and content of the interview responses, two researchers developed quantitative codes regarding training. Subsequently, four trained coders, working in pairs, used the codes to analyze the data, turning the qualitative interviews into quantitative variables. Pairs independently coded five of the same interviews, then discussed discrepancies and revised the codes to ensure exclusive and exhaustive categories. Initial qualitative open-ended interview responses were thus translated into quantitative data representing 49 states and reflecting training theme or code frequencies.

Five of nine training variables did not have responses from all 49 states. Data on perceived need for training were reported for 48 states, skills needed for 46 states, training goals for 29 states as already mentioned, training format for 46 states, and training time for 44 states.

Variables, which were missing cases, were examined for why they had fewer than 49 responses. CCC directors who expressed during interviews that they did not deem training as appropriate were not asked further about training format, duration, or perceived training skills. This accounted for the missing cases. The one missing case for the perceived need for training code was because of an “I don’t know” response, which was not coded.

Coding pairs independently coded 10 transcripts to check for intercoder reliability. Utilizing Cohen’s kappa, a measure of intercoder reliability for dichotomous data (Cohen, 1960), initial intercoder reliability revealed less than perfect agreement ($\kappa < 1.00$). Coders again discussed discrepancies and revised codes. Through this process, coders obtained 100% agreement ($\kappa = 1.00$) and proceeded to independently analyze the 49 transcripts. Coding pairs periodically met to resolve discrepancies and ensure 100% agreement. As a result of the perfect agreement between coders, a single code was created for each variable, composing the data set from which results were obtained.

Nine variables emerged from the training data: (a) overall attitude toward mapping, (b) need for training, (c) mapping capacity, (d) CE requirements, (e) perceived user skills, (f) training audiences, (g) training goals, (h) training format, and (i) duration of training. In addition, CCC programs were categorized by their stage of CCC funding, either planning or implementation. Data were analyzed using frequency counts and percentages to reveal CCC program directors’ perceptions of training needs regarding GIS mapping in CCC activities. Furthermore, chi-square analyses of relationships between training audience and user skills, audience and training goals, and audience across CCC stage were conducted.

► RESULTS

Participants provided information about their preferences for training on GIS mapping in nine areas, as previously identified. Results are organized around variables associated with a favorable environment for training and an assessment of training needs.

Organizational Environment for Training

CCC stakeholder opinion of GIS mapping. Most program directors (73.47%, $n = 36$) believed that their state CCC stakeholders held a favorable opinion of GIS mapping. However, one fourth of program directors ($n = 12$) indicated that CCC stakeholders were unaware of GIS as a potential tool for state cancer-control planning and evaluation. Two directors (4.08%) expressed

that stakeholders held an overall unfavorable opinion of GIS mapping.

Perceived need for training. The majority of participants (66.67%, $n = 32$) perceived a need for GIS training. The perceived need for training is consistent with 89.80% ($n = 44$) of directors saying that time should be allocated for training CCC employees on GIS mapping.

Geocoding capacity. At the time of the interviews, slightly more than half of the states’ cancer registries geocoded their cancer data, and CCC staff had access to this data for planning efforts. Of state cancer or tumor registries, 57.15% ($n = 28$) geocoded their data, 8.16% ($n = 4$) were in the process of geocoding their data, and 34.69% ($n = 17$) did not yet have their cancer data geocoded.

Needs Assessment

CE requirements. The majority of state CCC programs (85.71%, $n = 42$) did not require their staff to earn a minimum number of CE credits. However, 14.29% ($n = 7$) did require CE credits as part of their position or to fulfill conditions of an awarded grant.

Skills needed. The skills needed included three general areas: (a) how to judge map validity, (b) how to understand statistics used in maps, and (c) how to understand basic epidemiological relationships important for mapping. Skills perceived as important for judging the validity of a map included (a) understanding the limitations of maps (78.26%, $n = 36$), (b) checking for clearly labeled sources, titles, and legends (73.91%, $n = 34$), (c) understanding how to interpret use of color shading in maps (67.39%, $n = 31$), and (d) understanding the use of different geographic scales (45.65%, $n = 21$). Participants described the need for knowledge of statistics in three ways: 26.09% ($n = 12$) felt that knowledge of statistics is essential to understanding maps, 41.30% ($n = 19$) thought that knowledge of statistics is helpful but not required, and 10.87% ($n = 5$) said that statistics knowledge should not be required for nonexperts to use maps. Finally, 15.22% ($n = 7$) of program directors identified knowledge of epidemiology as an important skill for understanding maps.

The frequency with which program directors identified certain mapping skills differed depending on the stage of their CCC programs. The exception to this finding was that program directors in both the planning and implementation stages perceived understanding the limitations of mapping with equal frequency (see Table 1). Directors

TABLE 1
State Comprehensive Cancer Control Stage and Perceived Skills for Geographic Information Systems Mapping

<i>Perceived Skills</i>	<i>Stage</i>			
	<i>Planning</i>		<i>Implementation</i>	
	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>
Understanding limitations of mapping	77.78	7	77.78	28
Understanding map legend, source, and title	66.67	6	75.00	27
Understanding and interpreting color shading	77.78	7	63.89	23
Knowledge to interpret different geographic scales	66.67	6	38.89	14
Knowledge of epidemiology	11.11	1	16.67	6
Knowledge of statistics				
Essential	22.22	2	27.78	10
Mentioned, but not required	44.44	4	38.89	14
Not required	22.22	2	8.33	3
<i>n</i>		9		36

NOTE: *n* = 45. Within-group percentages are reported.

in the planning stage were more likely than directors in implementation to perceive as important (a) understanding color shading and (b) knowledge to interpret geographic scale. They also deemphasized the importance of statistical knowledge. On the other hand, directors in the implementation stage were more likely to deem as important (a) understanding map legends, sources, and titles, (b) knowledge of epidemiology, and (c) statistical knowledge.

Training goals. When asked about potential goals for GIS training, participants reported that training should teach participants to assess the reliability and validity of maps (48.27%, *n* = 14), generate maps (44.83%, *n* = 13) and read maps (44.83%, *n* = 13). In addition, 7 respondents (24.14%) thought that training should teach participants how to use maps specifically for cancer planning, and 6 respondents (20.69%) felt that understanding the limitations of maps was an important training goal. One CCC program director (3.45%) wanted to learn how to field questions from the general public.

Audiences for training. Respondents identified several audiences for GIS training. Participants recommended training epidemiologists (85.71%, *n* = 42), CCC staff (81.63%, *n* = 40), other public health staff (71.43%, *n* = 35), policy makers (67.35%, *n* = 33), and cancer-control coalition members (36.73%, *n* = 18). Two audiences consistently emerged with patterns different from other audiences in relation to training goals (see Table 2). CCC

directors identified cancer coalition members more frequently and policy makers less frequently compared to other audiences across five goals: (a) assessing map limitations, (b) using maps for planning, (c) generating maps, (d) assessing reliability and validity, and (e) fielding questions from the public. In addition, CCC directors who identified cancer coalition members as a key training audience were significantly more likely (45.45%) than directors who did not identify coalition members (5.56%) to say that learning the limitations of GIS mapping is an important training goal, $\chi^2(1, n = 29) = 6.6, V = .48, p = .01$.

Training format. When asked about their preferred format for training, respondents most frequently mentioned some form of in-class training. In all, 39.0% (*n* = 18) preferred in-class training only, 26.09% (*n* = 12) preferred in-class training that was supplemented with computer tutorials so that each trainee would be able to practice what the instructor demonstrated, and 23.91% wanted in-class and online training. Three interviewees elaborated, stating that they would like to have the option of going to in-class training and, after the class, have online tutorials available for practice at their workspace. Only 6.52% of program directors (*n* = 3) preferred strictly online training (with no in-class sessions), and another 6.52% of directors (*n* = 3) preferred videoconferencing. Finally, 30.43% (*n* = 14) of directors responded that the preferred training format would depend on the skill level of the audience.

TABLE 2
Training Audience and Goals for Geographic Information Systems Mapping

Audience	Training Goals (about Map Use)												n ^a
	Assess Reliability and Validity		Generate		Read		Use for Planning		Assess Limitations		Field Questions From the Public		
	%	n	%	n	%	n	%	n	%	n	%	n	
Epidemiologists	52.00	13	44.00	11	48.00	12	20.00	5	24.00	6	4.00	1	25
Comprehensive cancer control staff	50.00	13	46.15	12	46.15	12	26.92	7	23.07	6	3.85	1	26
Other public health staff	52.17	12	56.52	13	43.47	10	21.74	5	21.74	5	4.35	1	23
Policy makers	36.84	7	52.63	10	42.11	8	10.53	2	10.53	2	.00	0	19
Consortium members	54.55	6	63.64	7	54.55	6	36.36	4	45.45	5	9.09	1	11

NOTE: *n* = 26.

a. *n* value at the right-hand side of each row is the number of state comprehensive cancer control directors who identified the audience listed in the corresponding row.

Training duration. Preferred duration of training generally fell into two categories: Of directors, 47.73% (*n* = 21) preferred training time to be a few hours, and 45.45% (*n* = 20) preferred training to last approximately 1 day. Of respondents, 18.0% (*n* = 8) preferred 2-day training workshops with an incubation period to process information, practice, and have time to think of questions. Of interviewees, 11.0% (*n* = 5) stated that training workshops offered at an annual conference would facilitate attendance. Only 6.81% of interviewees (*n* = 3) estimated a training session lasting 1 week to be necessary to meet training needs.

► DISCUSSION

Lessons Learned

CCC stakeholders generally have positive opinions of GIS mapping for cancer control. Three fourths of CCC directors believe that their state's CCC stakeholders have positive opinions about GIS mapping for cancer-control activities. This support indicates a favorable environment for GIS training, as stakeholders have the power to allocate personnel time and financial resources to training and adoption of a new technology (Miranda et al., 2005).

The benefits of GIS will need to be demonstrated to stakeholders who are unaware of GIS mapping. Although most

stakeholders have favorable opinions about GIS mapping for cancer control, one fourth of CCC program directors believe that their state's CCC stakeholders are unaware of GIS mapping as a potential tool for health promotion and practice. For these states, benefits of GIS mapping for cancer control need to be demonstrated before offering training.

The GIS training in states where stakeholders have unfavorable opinions will need to focus on counterpoints. Although GIS support is mostly favorable, a few states do not have positive attitudes toward training for GIS mapping. The issues raised by those with unfavorable attitudes identify important barriers to the adoption of GIS mapping that need to be addressed both prior to and during training. These barriers include whether GIS mapping is suited for daily tasks and will be used frequently enough to justify the costs, how to allocate staff time for using GIS technology after the training, and privacy issues linked to mapping especially rural populations, where population numbers are small.

Training should address limitations of GIS mapping to avoid unrealistic expectations. Although positive opinions of GIS mapping are desirable, unrealistic beliefs about how GIS mapping can be used in cancer control may hinder training. If stakeholders and trainees are not made aware of the limitations of GIS mapping, they will

have expectations about GIS and training that cannot be met, hindering successful training outcomes (Vroom, 1995).

Perceived need for training indicates that the organizational climate is right for GIS training. Almost all CCC program directors believe that time should be allocated for sending employees to training sessions on GIS mapping. Organizational leader support is critical to successful training (Miranda et al., 2005), and the strong support of CCC leaders indicates that the climate is right for training. In addition, more than half of the directors believe that GIS mapping requires training and believing that there is a need for learning is critical to successful training outcomes (Knowles, 1980).

Most states have access to geocoded data, allowing trainees to apply what they learn. One condition necessary for successful training is that trainees have the resources necessary to perform the tasks they learn in training when they return to the work setting (Noe, 1986). If training is offered on how GIS mapping can facilitate cancer-control planning and resource-allocation efforts, trainees expect to be able to apply what they learned. Thus, part of the equation for successful training is organizational infrastructure, in this case access to geocoded cancer data. With more than half of states having their cancer data geocoded and with rapidly advancing GIS technologies automating the geocoding process, most states have the technical capacity to carry out GIS mapping. Thus, trainees can implement what they learn in their jobs. For the states without geocoded data, training should be delivered only if the trainees will be able to apply what they learn with their own data in the near future.

Most CCC programs do not require CE credits, so training should not be designed to fulfill CE credits. CE is a common mechanism for keeping the public health workforce up to date on scientific knowledge and information technology advancements. Although CE credits initially were perceived as a possible avenue for offering GIS training, few state CCC programs (14%) require CE credits of their staff. Thus, promoting GIS training as a means for fulfilling employee-mandated CE is likely to be ineffective. Alternative ways to promote GIS training might include encouraging GIS training as a means of increasing employees' repertoire of skills, improving employee and department image, increasing program credibility through evidence-based decision making, and creating potential career development paths. Additional research will need to be conducted to determine the most effective way to promote GIS training.

A learner-centered training approach can help training match expectations. Perceived skills needed to interpret GIS maps and goals for GIS training provide clear guidance for the development of a training program. By ensuring that training provides these skills and meets these goals, trainers will be following the learner-centered approach and increase the likelihood of positive outcomes (Noe, 1986). In addition, listening to what training audiences deem as unimportant, such as learning the underlying statistical concepts of GIS maps and understanding epidemiology, will assist in the development of effective GIS training for CCC staff.

Training needs to be tailored to the stage of the CCC programs. The stage of the CCC program (i.e., planning or implementation) reflects the length of time that a state has been involved in CCC planning. Programs in the different stages are likely using different applications of GIS mapping for different purposes. Training needs to be tailored to address these differing needs. CCC stage also can be used as a proxy for gauging knowledge of and prior exposure to GIS mapping, facilitating the development of appropriate training. A tailored training approach is likely to maximize learning and minimize participant frustration.

Several audiences are likely to benefit from training on GIS mapping, but the training needs to be tailored to their differing needs. Potential audiences for GIS training include epidemiologists, CCC staff, other public health professionals, policy makers, and CCC coalition members. These audiences are prioritized by CCC program directors as critical groups for GIS training and utilization. Because these audiences have different levels of knowledge about GIS and will likely be using GIS maps in different ways (e.g., policy makers for funding decisions, CCC staff for intervention design and evaluation, and epidemiologists for disease monitoring and surveillance), training should separately occur for these groups according to their prior knowledge and training needs (Table 2). For instance, policy makers will be held less accountable for assessing reliability and validity of maps, whereas epidemiologists and other audiences will be responsible for acquiring such skills. Likewise, cancer coalition members who may use maps when interacting with communities for outreach will need to be able to assess and understand the limitations of what messages maps can communicate.

In-class training is preferred. CCC directors who prefer in-class training, in-class training with computer tutorials, and both in-class and online training compose the majority of respondents. In-class training provides an opportunity to share personal experiences and receive

group feedback on applied cancer cases (Cordeiro, Kraus, Hastings, & Binkowski, 1997; Quinn, Albrecht, Marshall, & Akintobi, 2005). Several participants believe that learning from other group members' questions is a benefit of in-class training. Although most participants prefer in-class training, 30.43% of participants also feel that the preferred training format depends on the skill level of the audience. Several participants believe that beginners are especially likely to benefit from in-class training. A minority of state directors prefer strictly online training or videoconferencing. These participants cite lack of staff time and resources for training, large travel distances to get to training, and infrequent use of mapping as reasons they prefer online or videoconference training.

Training should last a few hours to one day. In an era of high daily work demands, the time spent in training must be effectively maximized (Trautmann, 2001). Participants prefer GIS training to last a few hours to one full day. A previous study on half-day training shows that modest impacts can be achieved when audiences are familiar with a training topic (Harrington et al., 2004). When the topic is new to audiences, half-day training results in weak impacts (Harrington et al., 2004). Balancing the material to be learned, audience expectations, work demands, and available time is critical to training success.

Limitations and Future Research

Although a near census was taken, only CCC directors were interviewed. Future research should include additional CCC members such as stakeholders, staff members, and cancer registry directors as the multiple audiences who will be using GIS for cancer-control activities.

► CONCLUSION

Effective public health leadership in CCC involves integrating technological advances into health promotion practice, especially when that technology can assist with cost-effective resource allocation. GIS mapping can assist CCC programs in prioritizing activities, monitoring disease incidence and prevalence, communicating information, and evaluating interventions. However, CCC staff members need to be equipped with the skills to effectively use GIS mapping. This assessment of training needs and preferences shows that CCC directors are receptive to GIS training. By adopting a learner-centered approach, trainers can make training as effective as possible and match the needs and preferences of their audiences.

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