

Strong and Flexible: Developing a Three-Tiered Curriculum for the Regional Central America Field Epidemiology Training Program

Pedagogy in Health Promotion: The Scholarship of Teaching and Learning 2015, Vol. 1(2) 74-82
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 DOI: 10.1177/2373379915572808
php.sagepub.com



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Abstract

Field Epidemiology Training Programs (FETPs) are recognized worldwide as an effective means to strengthen countries' capacity in epidemiology, surveillance, and outbreak response. FETPs are field-based, with minimum classroom time and maximum time in the field, providing public health services while participants achieve competency. The Central America FETP (CAFETP) uses a three-level pyramid model: basic, intermediate, and advanced. In 2006, a multidisciplinary team used a methodical process based on adult learning practices to construct a competency-based curriculum for the CAFETP. The curriculum was designed based on the tasks related to disease surveillance and field epidemiology that public health officers would conduct at multiple levels in the system. The team used a design process that engaged subject matter experts and considered the unique perspective of each country. The designers worked backwards from the competencies to define field activities, evaluation methods, and classroom components. The 2006 pyramid curriculum has been accredited for a master's of science in field epidemiology by the Universidad del Valle de Guatemala and has been adapted by programs around the world. The team found the time and effort spent to familiarize subject matter experts with key adult learning principles was worthwhile because it provided a common framework to approach curriculum design. Early results of the redesigned curriculum indicate that the CAFETP supports consistent quality while allowing for specific country needs.

Keywords

competencies, curriculum, epidemiology, global, adult learning

Introduction

Field Epidemiology Training Programs (FETPs) are recognized worldwide, including by ministries of health, as an effective means to strengthen countries' capacity in epidemiology, surveillance, and outbreak response (Schneider, Evering-Watley, Walke, & Bloland, 2011). These programs are field-based, with minimum classroom time and maximum time in the field, providing services to ministries of health while achieving competency. FETPs offer unique programs that respond to the public health priorities of the countries and regions in which they reside (Cardenas et al., 2002). As of July 2014, The Centers for Disease Control and Prevention (CDC) has helped support the development and implementation of 48 two-year field epidemiology training programs, covering 67 countries around the world (CDC, unpublished data).

The Central America region has supported field epidemiology training programs since 2000, when a regional

program was established in response to the devastation of Hurricanes Georges and Mitch (López & Cáceres, 2008). The Central America FETP (CAFETP) provides a means to develop capacity for six countries: five in Central America and the Dominican Republic.

At its inception, the CAFETP identified three levels within a country's health system where field epidemiology skills are needed: national, provincial, and

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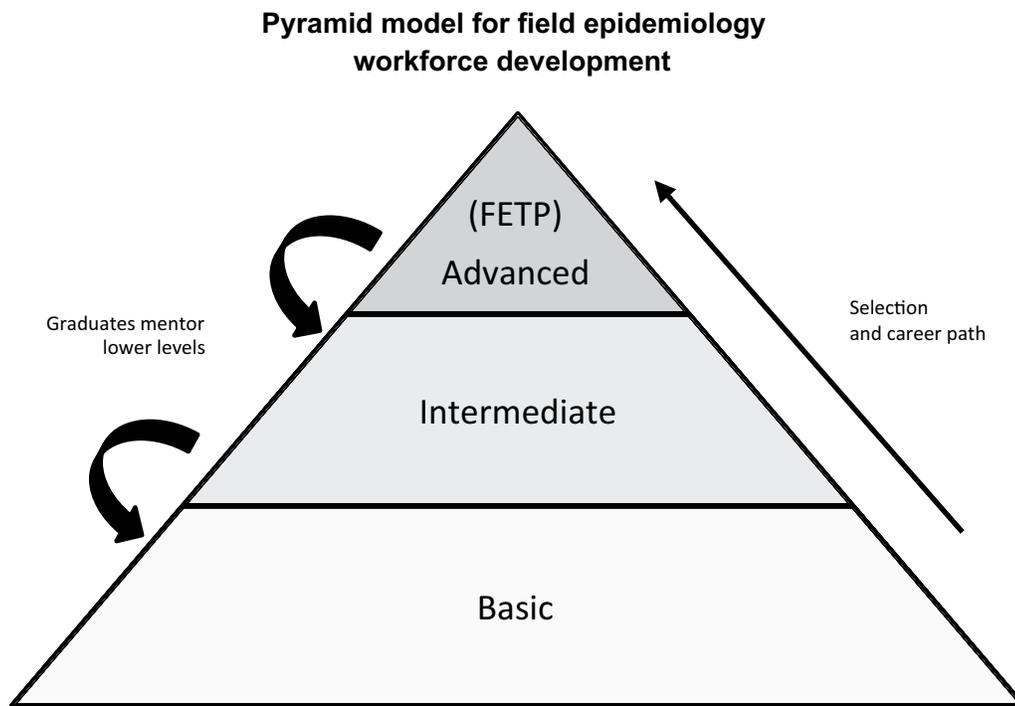


Figure 1. The pyramid design enables participants to progress in their development while mentoring others.

district. Recognizing that skilled staff were needed at all levels to detect and monitor disease outbreaks and better inform public health decision making, the CAFETP was designed with a three-tiered approach.

At the basic level, health workers, usually working at the subnational level, participate in a 3- to 4-month on-the-job program to gain skills appropriate for their responsibilities within the system. Practical assignments that benefit their work unit are supplemented with classroom instruction. On completion of the basic level, a subset of graduates progresses to the intermediate level. There they conduct more complex data analysis, design and conduct planned studies, contribute to epidemiologic bulletins, and present scientific data to decision makers in the health system. This level, which lasts 9 months, is also supplemented with periodic classroom instruction. A still smaller group advances to the highest level of the pyramid, the 2-year advanced level, where they achieve competencies and provide services in field epidemiology, surveillance, outbreak response, and planned research. Regardless of whether they continue through all levels or stop after just one, professionals obtain competencies that will enable them to substantively contribute to surveillance and outbreak response.

The CAFETP advanced level is similar to other 2-year FETPs worldwide. At this level, residents frequently deploy full-time to a specific division in the ministry for a 2-year assignment. Field assignment locations can be anywhere in the ministry where field epidemiology skills are needed, such as in a disease surveillance or outbreak

response unit. The field assignment location benefits from the services the resident provides while enabling the resident to practice new skills (López & Cáceres, 2008). At all three levels of CAFETP, emphasis is placed on field work, with classroom time taking approximately 20% of the participant's time.

CAFETP is designed to reinforce itself by providing a means to build skills for career advancement and to supply skilled mentors to support participants just below them in the pyramid. Participants at the intermediate level mentor those at the basic, while they in turn are mentored by advanced participants (Figure 1).

With a three-level pyramid structure, the design of the CAFETP is complex. At all levels, it must guarantee consistent levels of quality across countries and academic institutions, while allowing for customization at the country level. A 2004 program evaluation revealed opportunities to improve the design and implementation of the program (Ruiz, Ortiz, & Martínez-Navarro, 2004). For example, instances of duplicate effort were identified as countries in the region independently created their own classroom materials. Recommendations from previous evaluations had been implemented inconsistently (Suárez-Rangel, López, & Cáceres, 2006a). Some countries had experienced great success that others wanted to replicate. For all these reasons, in 2006 a multidisciplinary team undertook a reformation of the curriculum.

With this article, the authors will share the process we used for the redesign of a complex workforce development model that considered multiple stakeholders in a

low-resource setting. We also intend to demonstrate that the redesigned curriculum provides sufficient structure to assure quality standards while being sufficiently flexible to respond to a country's unique needs.

Background

A curriculum is "a complete set of learning experiences, including classroom, experiential, and self-guided that taken altogether achieve a desired set of competencies" (Center for Public Health Policy Columbia University School of Nursing, 2008). A curriculum designer breaks down the competencies into a more detailed "hierarchy of objective" (Molenda, Pershing, & Reigeluth, 1996). From this the designer develops evaluation methods and instructional materials. For the purpose of this article, we will call the hierarchy of objectives the curriculum roadmap. The CAFETP curriculum roadmap is based on the defined responsibilities that are required for successful epidemiologic practice at each level of the system. For this reason, the CAFETP roadmap is called "field-based." Starting with the field responsibilities, the roadmap guides classroom content, including exercises, lectures, and examinations. It also guides the sequencing of the field activities as well as the criteria by which field work would be evaluated.

Redesigning the curriculum of an active FETP presented several challenges. The greatest of these was that training activities were underway throughout the region, with some countries conducting training at all three levels. This meant that the design team had to consider the consequences of changes to field assignments and classroom activities for participants and staff who already had expectations of how the program would flow. Another challenge was the geographic location of the stakeholders. The design team was based at the Centers for Disease Control Atlanta, USA, and Guatemala City, Guatemala, offices. Key stakeholders were present throughout the Central America region, making communication and coordination difficult. To add to the complexity of the program, stakeholders determined that university accreditation would be critical for program quality and sustainability.

Method

The final product needed to make sense as a progression of building blocks, as well as stand-alone programs with specific objectives and deliverables. To develop a curriculum roadmap that is flexible enough to meet the current and future needs of the diverse countries in the Central America region, the team applied three key principles, which are described below.

Begin With What Works

We used as our starting point CDC's recommended FETP standard curriculum (Traicoff et al., 2008). We also

reviewed the curricula of FETPs in the Americas, reports from other FETPs in the region, and the existing training materials of the CAFETP.

Ask the Experts

Mindful that data analysis, outbreak detection, and outbreak response operate at multiple levels within a health system, we conducted a task analysis to define realistic responsibilities for data analysis, outbreak detection, and outbreak response at each of the three levels of the pyramid. Using worksheets based on the standard curriculum, we conducted workshops and interviews with epidemiologists who were experienced in the geographic, political, and health environments of the Central America region and who had demonstrated expertise in surveillance, disaster response, and program management. The epidemiologists considered the job responsibilities specific to disease surveillance and response that a health worker would be expected to perform at each level of the system. Their responses defined the competencies that would be required at each level. The epidemiologists then reviewed each learning objective with two questions in mind:

- At what level within the pyramid does this activity fall?
- Should this learning objective be required or should it be optional based on a country's priorities (Suárez-Rangel et al., 2006a)?

Using Microsoft® Excel, the design team then collated and analyzed the responses. For example, the El Salvador representative felt that calculating descriptive statistics should be included at each level, but the level of proficiency should be different (Figure 2).

Use Adult Learning Approach

Well-established principles of adult learning informed our approach to the curriculum redesign process (Bryan, Kreuter, & Brownson, 2009; Knowles, 2012). Specifically, the following traits of the adult learner were taken into consideration:

- Adults are motivated to learn when they perceive a practical application.
- Adults prefer real-world problem-focused learning rather than subject-focused learning.
- Adults learn best when they have a measure of control over their experience.
- Adults bring valuable experience into the learning environment and learn best when those experiences are connected to the learning experience.
- Individual differences among people increase with age; therefore an adult learning environment

| Field Epidemiology Training Program Worksheet-El Salvador Responses | | | | | | | | | | | | | | |
|---|---|---|------------|------------|--------------------|---|------------|-------------|-------|---|------------|------------|-------|---|
| Domain | Instructional Goal | Advanced Level | | | Intermediate Level | | | Basic Level | | | | | | |
| | | M=mandatory O= optional No= do not include | Proficient | Functional | Aware | M=mandatory O= optional No= do not include | Proficient | Functional | Aware | M=mandatory O= optional No= do not include | Proficient | Functional | Aware | |
| Biostatistics | Calculate descriptive statistics | M | X | | | | | X | | M | | | | X |
| Biostatistics | Present data using tables, graphs, charts & maps | M | X | | | | | X | | M | | | | X |
| Biostatistics | Use non-parametric statistical tests | M | | X | | | | | X | O | | | | |
| Communication | Prepare reports for presentation to decision makers and policy makers | M | X | | | | | X | | M | | | | X |
| Epidemiologic Methods | Analyze and interpret data by person, place and time | M | X | | | | | X | | M | | | | X |
| Biostatistics | Describe and apply probability distributions | M | X | | | | | X | | O | | | | |
| Biostatistics | Perform statistical tests such as Students t, Chi-square, and Fischer's Exact | M | X | | | | | X | | M | | | | |
| Biostatistics | Determine sample size for a survey | M | X | | | | | | | M | | | | |
| Biostatistics | Calculate linear regression | M | X | | | | | | | NO | | | | |

Figure 2. Needs assessment responses El Salvador (portion).

considers differences in learning style and methods (Knowles, 2012).

Designing training based on competencies is a widely recognized best practice for the public health workforce (Koo & Miner, 2010). A *competency* is an integrated set of knowledge, skills, and attitudes that supports successful performance in public health service delivery (Traicoff et al., 2008). Based on the defined competencies, we conducted additional meetings to define the instructional goals and learning objectives at the appropriate level.

After 6 months of work, the design team convened a workshop to present preliminary results and gather information for the subsequent steps of the curriculum development (Suárez-Rangel, López, & Cáceres, 2006b). Advanced-level CAFETP graduates, supervisors, and program coordinators in Guatemala City participated in the workshop. After being introduced to some basic principles of adult learning, the participants worked in small groups to review the learning objectives at each level of the pyramid. They recommended the appropriate level of each objective and suggested which objectives could be electives.

From this work, we compiled a tiered list of competencies and instructional goals based on the services that were needed by the ministries of health in the region. For example, the tasks related to outbreak investigation are often completed by several individuals, each possessing a different set of responsibilities and skills. Expected tasks related to outbreak response are “Support an outbreak investigation team” for the basic level, “Investigate an outbreak” and “Conduct an analytic study within the context of an outbreak” for the intermediate level, and “Lead an outbreak response team” and “Implement control measures” at the advanced level. These tasks were documented as instructional goals in the curriculum roadmap, and they informed the field activities that were required. Continuing with the example of outbreak investigation, the required field activity progresses from “Participate in at least one outbreak investigation” for the basic level, “Conduct at least one field investigation of urgent public health concern and publish the results” for intermediate, and “Lead at least two and participate in at least two field investigations of public health interest which require immediate response” (Figure 3). A final document organized the expected competencies, instructional goals, learning objective, and topics (Figure 4, Supplemental Figure 1, available from php.sagepub.com/supplemental). “At a glance” summaries depicted all the topics for each level in one-page charts.

We held sessions with stakeholders and team members to review the curriculum roadmap and walk through the progression from basic to intermediate and advanced levels, with the reviewers checking for unclear verbiage, redundancies, or gaps from one level to the next. A major stakeholder, the Universidad del Valle de Guatemala (UVG), advised and ensured that academic requirements

were met while remaining true to the “training through service” nature of the program.

When the draft curriculum roadmap was almost complete, work began on the next phases of the design: determining the order of the course work, and determining which learning objectives could or should be delivered distance-based, such as through webinars or self-paced tutorials. With a new cohort for the advanced level scheduled to begin 4 months later, we decided to develop classroom materials for the advanced level first. Based on the order of the required field activities for the residents in the advanced course, we defined the order and content of six distinct courses (modules) that would be offered.

Based on its experience in developing and delivering high-quality continuing education programs for health professionals, we engaged the University of North Carolina Center for Public Health Preparedness for the development of classroom materials. Since adult learning practices emphasize practical application, coursework was designed based on the expected field work that would be conducted subsequently. For example, after completing a course on analytic study design, residents would work at their field site to complete their study protocol and then present their protocol at the subsequent course. Clearly defined learning objectives informed the development of lectures, exercises, and exam questions. In turn, the related field assignment is a powerful cross-check to ensure that classroom activities support work in the field.

Results

In March 2007, we piloted the new advanced level course materials in Guatemala City with a cohort of advanced level CAFETP residents (Alonso, Suárez-Rangel, López, & Jara, 2007). UVG completed its process to accredit the program so that successful graduates obtain a master’s in science in field epidemiology. Shortly thereafter, we began to develop training materials for the basic and intermediate levels. In addition, a curriculum blending self-paced online tutorials and classroom instruction was developed to prepare the mentors (“tutors”) to support participants of the advanced level of the pyramid (Suárez-Rangel & Díaz, 2011). Again, the pyramid curriculum roadmap was useful; this time to develop guidelines and checklists for the mentors to measure the quality of the residents’ work.

The materials for the basic level of the pyramid were introduced in 2010 in Belize and Panama. In 2011, the new version of the intermediate level was implemented in the Dominican Republic and Guatemala (Suárez-Rangel, Díaz, Aramburu, & López, 2011).

After modules were delivered for the first time, the training materials and course schedules were reviewed to correct content and produce a “final” version. Quality is reviewed whenever modules at any of the three levels are delivered. In addition, program faculty conducts

| Field Activities by Level | | |
|---|--|--|
| Basic | Intermediate | Advanced |
| Participate in at least one outbreak investigation | Analyze surveillance of at least one disease of national and local priority | Lead at least 2 and participate in at least 2 field investigations of public health interest which require immediate response. |
| Presentation of at least one outbreak investigation at the local level | Conduct at least one field investigation of urgent public health concern and publish the results | Analyze and evaluate at least one surveillance system |
| Analyze data for at least one existing surveillance system | Develop a protocol and conduct a planned epidemiologic investigation | Participate in the design, management, data analysis and reporting of at least one field study (cross sectional) |
| Presentation of at least one surveillance analysis at the local level | Conduct a health situation analysis in one's area of responsibility | Plan, develop the protocol and conduct one epidemiologic study of a national priority public health problem, infectious or non-infectious. |
| Report of a meeting with local authorities during which decisions were made based on either data analysis or outbreak investigation | Mentor at least 5 residents at the basic level of the field epidemiology training program | Deliver at least one oral presentation at an international conference |
| | Participate with the intermediate cohort in a group investigation | Deliver oral presentations at meetings of organizations at the local or national level |
| | Submit an investigation for presentation at a national or international conference | Write and publish an article in a national or regional journal or bulletin. |
| | Submit an investigation to the epidemiologic bulletin | Write and submit for publication a manuscript for an international peer-reviewed journal |
| | | Appropriately respond using either oral or written method regarding public health issues to a variety of audiences including media, the general public, government or health professionals |
| | Teach a class at the basic or intermediate level and/or serve as a mentor to residents at the intermediate level | |

Figure 3. Required field activities based on necessary epidemiologic services.

periodic reviews to ensure that the classwork contains sufficient and appropriate activities to prepare residents for their field assignments. Since the launch of the new model, 80% of the advanced level will graduate on time compared with 40% of the 2009 cohort and 0% in 2007.

A 2014 regional dialog included setting indicators for country programs. As countries complete their long-term plans, they intend to include metrics to measure impact based on their ministry's expectations for each level of the pyramid. For example, at the basic level, countries expect more efficient detection of priority diseases at the local level. The quality of participants' surveillance reports during and after the program can provide data regarding this indicator.

Discussion

The design and packaging of the training materials have made it possible for easy customization by academic

and governmental organizations within the Central American region and beyond. For example, at the UVG, the schedule for the basic level was modified to accommodate alternative audiences, such as veterinarians for the Ministry of Agriculture and Livestock and internal medicine residents.

The consistency in skills of participants because of the program's new design contributed to the ability of a multicountry team to respond to the 2010 earthquake in Haiti (Ferrand, Lerebours, Pimentel, & Suárez-Rangel, 2010). CAFETP graduates in the Dominican Republic assisted in the development of rapid needs assessments of Haitian earthquake victims who had been relocated to their country. In another example, most of the Rapid Needs Assessment teams that deployed following Storm Agatha in Guatemala in 2010 were led by an advanced level CAFETP resident.

The newly designed FETP pyramid curriculum was quickly adopted in a variety of settings, both within the region and around the world.

| Level | Competency Statement | Instructional Goal | Learning Objectives |
|--------------|--|--|---|
| Advanced | Use epidemiologic practices to design and conduct studies that improve public health program delivery | Create tables, graphs, charts and maps for data analysis | <ul style="list-style-type: none"> • Conduct complex analyses such as time series graphs • Implement and evaluate recommendations based on data analysis • Discuss when to perform a stratified analysis |
| | | Analyze and interpret data from descriptive and analytic studies | <ul style="list-style-type: none"> • Calculate a summary risk estimate using the Mantel and Haenszel test • Identify presence of confounding using stratified analysis • Describe how matching controls for confounding • List the advantages & disadvantages of matching • Calculate matched & unmatched measures of association in a case control study • Differentiate between the biases of effect modification and confounding • List 3 methods to control for confounding • Identify the presence of effect modification in a data set • Present findings to express effect modification • Identify biases in cohort and case control studies, including recall, selection & diagnosis • Identify confounding factors in an analytic study • Minimize bias when designing and conducting analytic studies • Explain design effect in non-technical terms |
| Intermediate | Use epidemiologic practices to conduct observational studies that improve public health program delivery | Analyze data from descriptive studies | <ul style="list-style-type: none"> • Construct a 2-by-2 table, tabulating the occurrence of disease and exposure in study participants • Calculate absolute risk (risk and rate difference), relative risk, rate ratio, and odds ratio • Generate hypotheses from descriptive data • Distinguish the terms “association” and “risk factor” • Analyze a survey dataset • Analyze data from a cluster survey • Calculate the prevalence odds ratio • Calculate the prevalence ratio • Explain the differences between the two & when to use them • Identify limitations of cross sectional studies |
| Basic | Analyze descriptive data to inform public health action | Analyze and interpret data from descriptive and analytic studies | <ul style="list-style-type: none"> • Prepare a line listing in terms of time, place & person • Count cases in terms of time, place & person • Summarize data in a line listing by time, place & person in terms of absolute numbers, proportions and rates • Identify hypotheses from descriptive data • Make actionable recommendations based on analysis |
| | | Create tables, graphs, charts and maps for data analysis | <ul style="list-style-type: none"> • Select the appropriate method to: <ul style="list-style-type: none"> ○ Prepare a table w/ 2 variables ○ Prepare line graphs ○ Prepare bar charts ○ Prepare dot density maps • Develop an endemic curve to detect outbreaks at the community level |

Figure 4. Sample tiered curriculum related to the data analysis topic.

- Angola, Botswana, Ethiopia, and Mozambique are using the pyramid curriculum as a template for their own programs.
- The Caribbean FETP and FETP Haiti chose to begin their programs at the intermediate level. FETP Haiti adapted CAFETP materials, tools, and methodology for their unique needs. Per the pyramid design, two Haitian epidemiologists who

completed the advanced level with a CAFETP cohort are serving as mentors to the intermediate-level residents.

- Using the CAFETP materials as a guideline, the director of the FETP Colombia has adopted the curriculum and conducted a workshop for tutors.
- FETP Paraguay, responding to a request for a workshop on vaccine-preventable diseases (EPI), used

case studies and exercises from the CAFETP curriculum in a customized workshop.

- In 2010, the Pan American Health Organization regional plan recommended the three-tiered design as a strategy to develop field epidemiology in the Americas (Pan American Health Organization, 2010).

Challenges

There were several challenges to overcome during the FETP redesign process. Logic would suggest beginning with development of the basic curriculum and then continue up the pyramid. However, FETPs were already operational throughout the region, and a new advanced-level cohort was on the horizon in the coming year. We were forced to develop the curriculum content for the advanced-level first, anticipating that when all components were eventually finished they would connect smoothly into each other. To add to the challenge, because the advanced level is a 2-year program with six distinct training events (modules), as one module finished we immediately began development of the subsequent module, with limited resources to incorporate constructive feedback into the prior modules. There were also challenges in the delivery phase. The faculty required orientation to the new materials and sometimes required refresher training for the more technical content. Some of the advanced-level residents who were the first to use the newly designed materials had not yet completed the basic and intermediate levels. Remedial training will continue to be incorporated into the advanced level until all cohorts are able to begin the program per the new design. More than 80% of the 22 residents in the 2013 advanced-level cohort have completed the pyramid curriculum per its intended design.

Conclusion

While it is early to comprehensively evaluate the redesigned curriculum, there are some promising indications that the curriculum and the method by which it was designed are a sound means of building the capacity of the public health workforce.

The CAFETP curriculum supports multiple levels of the region's health systems and provides data for decision making. The CAFETP pyramid model is being requested by FETPs around the world—the multitiered approach to building capacity seems to reflect the complexity of today's public health systems. The development of a curriculum to support the tutors enables graduates to continue their skill development.

The process to develop a hierarchy of competency-based objectives takes time and effort. A multidisciplinary team with expertise in epidemiology, surveillance, and adult learning as well as familiarity with the health,

political, and societal challenges of the region can help a program stay focused on public health priorities of the region. The time and effort to familiarize subject matter experts with key adult learning principles is worthwhile and necessary to help the entire team be consistent in its approach to curriculum design. This approach resulted in curriculum that supports consistent quality while allowing for specific country needs.

Acknowledgments

The authors are grateful to Carlos Alonso, Celia Cordon-Rosales, and Javier Aramburu for their commitment to excellence and their contributions to the project. We thank Fred Angulo and Bob Fontaine for their careful editing and helpful comments. We also thank our valued partners in the Ministry of Health Guatemala, the CDC Regional Office for Central America and Panama, and the national coordinators for the field epidemiology training programs in the Ministries of Health of Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua.

Authors' Note

University of North Carolina Center for Public Health Preparedness worked in partnership with the Universidad del Valle de Guatemala, the CDC Regional Office for Central America and Panama (CDC-CAP), and CDC Atlanta through a 4-year cooperative agreement with the Association of Schools of Public Health and the CDC Center for Global Health.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Supplemental Material

Additional supporting information is available at php.sagepub.com/supplemental.

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