



Non-communicable disease training for public health workers in low- and middle-income countries: lessons learned from a pilot training in Tanzania

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Background: Non-communicable diseases (NCDs) are increasing worldwide. A lack of training and experience in NCDs among public health workers is evident in low- and middle- income countries.

Methods: We describe the design and outcomes of applied training in NCD epidemiology and control piloted in Tanzania that included a 2-week interactive course and a 6-month NCD field project. Trainees (n=14 initiated; n=13 completed) were epidemiology-trained Ministry of Health or hospital staff. We evaluated the training using Kirkpatrick's evaluation model for measuring reactions, learning, behavior and results using pre- and post-tests and closed-ended and open-ended questions.

Results: Significant improvements in knowledge and self-reported competencies were observed. Trainees reported applying competencies at work and supervisors reported improvements in trainees' performance. Six field projects were completed; one led to staffing changes and education materials for patients with diabetes and another to the initiation of an injury surveillance system. Workplace support and mentoring were factors that facilitated the completion of projects. Follow-up of participants was difficult, limiting our evaluation of the training's outcomes.

Conclusions: The applied NCD epidemiology and control training piloted in Tanzania was well received and showed improvements in knowledge, skill and self-efficacy and changes in workplace behavior and institutional and organizational changes. Further evaluations are needed to better understand the impact of similar NCD trainings and future trainers should ensure that trainees have mentoring and workplace support prior to participating in an applied NCD training.

Keywords: Chronic disease, Developing nations, Non-communicable disease, Public health worker, Training

Introduction

Non-communicable diseases (NCDs), those not transmitted from person to person (e.g., cardiovascular disease, respiratory diseases, cancer),¹ are the greatest contributors to morbidity and mortality in the world, particularly in low- and middle-income countries (LMICs). A study of 187 countries showed that from 1990 to 2010, disability-adjusted life years (DALYs) increased

from 43 to 54% for NCDs, 10 to 11% for injuries, but decreased from 47 to 35% for communicable, maternal, neonatal and nutritional disorders.² According to WHO, 80% of global NCD-related deaths in 2005 occurred in LMICs.¹ A study of sub-Saharan African countries showed that from 1990 to 2010, NCD-related DALYs increased by 45%.³ For example, in Tanzania in 2008, 27% of deaths were due NCDs, 39.2% of population had high blood pressure, 27% were overweight or obese and 22% had

high cholesterol.⁴ The rise of NCDs in LMICs is concerning given their high burden of communicable diseases, lack of resources and unstable public health systems,^{1,5,6} which could lead to late detection of disease and inadequate treatment.

Global public health leaders are concerned about not having a public health workforce in LMICs that is sufficiently trained in NCDs to adequately detect and prevent NCDs.^{1,5-7} The majority of government-sponsored trainings for public health workers in LMICs have traditionally not focused on NCDs.⁸⁻¹³ In 2009, the CDC Center for Global Health, in collaboration with CDC's Office of Non-communicable Diseases, Injury, and Environmental Health, began an initiative to help countries improve their surveillance systems and build their workforce capacity to appropriately respond to the high burden of morbidity and mortality from NCDs. As part of this NCD initiative, the CDC collaborated with the Ministry of Health (MOH) in five countries (Tanzania, China, Colombia, Jordan and Thailand), countries with established Field Epidemiology Training Programs (FETP) and national NCD efforts, to train public health workers from a variety of health fields, work settings and career levels in NCD prevention and control. Given the success of CDC-supported 'applied' trainings for public health workers that integrate practice at work (e.g., through field projects), such as the Epidemic Intelligence Service Program for United States public health professionals¹⁴ and FETPs for MOH workers,¹⁵ applied trainings were proposed. While other NCD-related trainings exist,¹⁶⁻²⁰ these are seldom applied and not easy to attend (e.g., due to distance, duration, resources). Thus, in addition to implementing NCD training within FETPs, the CDC aimed to make the NCD training materials available for public use.

We piloted an applied NCD epidemiology and control training in May 2011 in Dar es Salaam, Tanzania. This training included a 10-day course and a 6-month field project. The main objectives of this training were to: 1. improve knowledge, skills and self-efficacy in NCDs; 2. improve or increase the number of NCD workplace practices/behaviors; 3. improve or increase the number of NCD-related institutional/organizational activities and policies (including surveillance systems). These improvements among the public health workers participating in the training would conceivably lead to better detection and prevention of NCDs. Our objectives for the pilot were to evaluate the training's effectiveness and identify training areas needing improvement. In this paper we describe this training and present findings from its evaluation.

Materials and methods

Theoretical framework

The training was based on the: experiential learning theory,²¹ which postulates that learning occurs through experience; transfer of learning theory,²² which suggests skills gained are transferred to the work environment and the model of change for health professionals,²³ which has been adapted for other trainings for public health workers.^{12,24} Our evaluation was based on the four levels of Kirkpatrick's evaluation model²⁵ for measuring a training's effectiveness: Level 1 (reaction): trainees' perceptions and reactions towards the training; Level 2 (learning): trainees' learning or achievement of training objectives; Level 3 (behavior): trainees' transfer of knowledge and skills from the classroom to the workplace; Level 4 (results): tangible results from the training (e.g., institutional activities and policies).

As shown in our model (Figure 1), the activities within our training can be evaluated using Kirkpatrick's evaluation model. Specifically, a well-received (reaction) course increases knowledge and skills (learning) that leads to self-efficacy, improved workplace performance (behavior), and trainee-initiated institutional/organization NCD activities (results). Field projects provide a mechanism for the trainee to practice his/her skills, (further increasing learning) and projects based on work data can increase results. The CDC mentors, the training coordinator and work supervisors enhance learning through their contributions to the field projects.

Curriculum development

CDC and the Tanzania Field Epidemiology Laboratory Training Program (TFELTP),⁸ a program supported by the Tanzania Ministry of Health and Social Welfare, identified institutions that could contribute to the NCD curriculum and training. Muhimbili University, University of Copenhagen (given their well-known global NCD epidemiology course)²⁰ and the National Institute for Medical Research (given their technical support of and contributions to the TFELTP program) were involved. In 2010, needs assessment meetings were conducted in Tanzania with staff and faculty from these institutions to gain recommendations from subject matter experts and to ensure that training covered the country's needs. An instructional designer from Deloitte Consulting led the curriculum development in collaboration with the University of North Carolina, which had prior experience in curriculum development for FETPs.

Course design

The 10-day course (approximately 8-hours/day) was conducted in a classroom within the TFELTP offices in Dar es Salaam. The course, delivered over 9 days, included 14 modules related to NCD prevention, control and health promotion and an Epi Info (CDC, Atlanta, GA, USA) and Excel tutorial (Microsoft Office, Redmond, WA, USA) (Table 1). Day 10 was allocated for field project conceptualization. Facilitators were trained by the instructional designer to teach the course using a learner-centered approach,²⁶ delivering interactive presentations that incorporated NCD concepts and group discussions. At the completion of each module, trainees completed practice exercises to ensure mastery of the learning objectives. Modules and Facilitator Guidelines are currently available in the public domain.²⁷ The Epi Info tutorial was a modified version of the CDC's 'Epi Info Community Health Assessment Tutorial'.²⁸

During course planning, we discussed potential trainees for the pilot in Tanzania. The goal was to invite public health workers from Tanzania or surrounding countries (i.e., regional training) that would benefit from the training and promote NCD activities in their workplace. Trainees who were only able to attend a few lessons were classified as 'observers' and were not expected to complete field projects. They were, however, encouraged to participate in class discussions and practice exercises.

Training coordinator and course facilitators

A Tanzanian public health specialist with NCD experience was hired to serve as the training coordinator. The coordinator assisted with the planning and implementation of the training and its evaluation, follow-up of course trainees and supervision of the

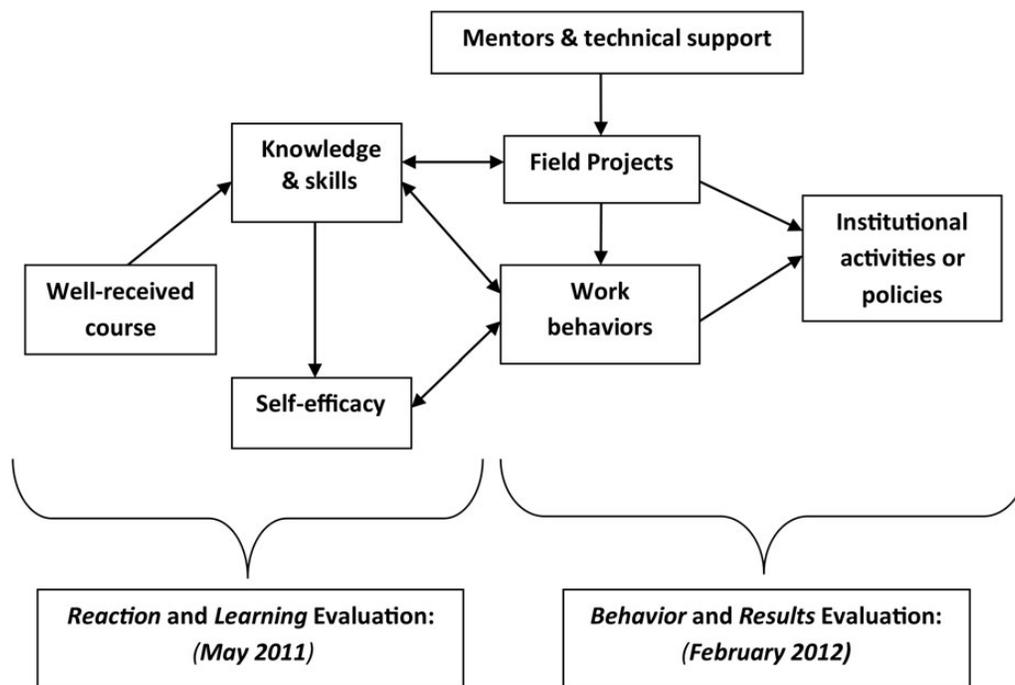


Figure 1. Model for the non-communicable disease (NCD) training for public health workers. This conceptual model illustrates the relationship between the training's components and objectives and the 4 levels for evaluating training, according to Kirkpatrick's evaluation model.²⁵

field projects. Course facilitators included two chronic-disease lecturers/physicians from the University of Copenhagen, four epidemiologists from TFELTP and four CDC-Atlanta epidemiologists; two of the CDC-Atlanta epidemiologists also served as field project mentors.

Field project design

Two-person, 3-month field projects were originally requested from trainees; participants not residing in Tanzania were allowed one-person projects. A month after the course ended, a few trainees reported difficulty with this plan because of lack of time, prior work responsibilities and conflicting schedules. The coordinator also reported a delay in project proposals and data acquisition. As a result, field projects were not required but recommended, the timelines for completing them was extended from 3 to 6 months, and one-person projects were allowed.

We instructed trainees proposing field projects to: 1. perform secondary analyses using existing data, preferably from their workplace; 2. obtain the necessary institutional approval for using these data; 3. use Epi Info for managing and analyzing their data and Excel for creating graphs; 4. provide a written project report; 5. create a Power Point presentation. Trainees were to provide initial project drafts to the coordinator, who communicated with the trainee via email, phone, or in-person; revised drafts were forwarded to the two CDC-Atlanta mentors for further suggestions. All project topics were screened for their potential to produce an institutional or organization activity or policy. Projects considered unfeasible were asked to be revised. The coordinator encouraged trainees to seek additional guidance from their workplace

supervisor and TFELTP staff; mentors consulted subject matter experts whenever needed.

Presentation day

In February 2012 (8 months after the course), trainees gave 20-minute oral presentations about their completed field projects and submitted a final report. Trainees' supervisors, course trainees and 'observers' were invited. The training coordinator, the two CDC mentors, TFELTP staff, three supervisors and two observers attended the presentations. Following the presentations, trainees and supervisors individually completed an 8-month evaluation form.

Evaluation instruments

The training was evaluated using the following: 1. Overall course evaluation forms containing closed-ended and open-ended questions about course satisfaction (e.g., did course meet expectations, which modules were liked the most, what was not liked about the course) completed by trainees on the last day of the 10-day course; used to measure reaction; 2. Module-specific evaluation forms containing likert-scale questions about retrospective change in self-reported competence levels completed by trainees after each of the 14 modules; used to measure learning; 3. Pre-post tests with 27 multiple-choice questions from various modules completed by trainees at day 1 and day 10 of the course; used to measure learning; 4. Trainee-completed 8-month evaluation forms containing closed-ended and open-ended questions about the topics and skills used at work and in the field projects; used to measure behavior and results; 5. Supervisor-completed evaluation forms containing closed-ended and open-ended questions about the field

Table 1. Most commonly self-reported competence level (1: not at all confident; 2: not very confident; 3: somewhat confident; 4: very confident; 5: completely confident)^a 'before' and 'after' completed the 2-week course

Modules and corresponding competencies (learning objectives)	Before	After
1. Introduction to NCD epidemiology (day 1) Identify core functions and terms in public health and epidemiology; describe how you will use epidemiology to influence public health.	3	5
2. NCD burden of disease (day 1) Calculate incidence, prevalence, mortality, QALYs and DALYs.	4	5
3. Prioritizing public health programs (day 2) Identify the key stakeholders and partners with whom to prioritize public health problems; identify the criteria for prioritizing public health problems; reach consensus on the two highest priority NCDs on which to focus prevention and control efforts.	3	5
4. NCD surveillance (day 2) Determine if a surveillance system is active or passive; depict the flow of data from the source, to the point where data are analyzed, to the point of dissemination of information and results; identify the strengths and limitations of a surveillance system in terms of data collection, data analysis and data dissemination; identify possible sources of selection and information bias in a surveillance system; articulate recommendations for improvement of a surveillance system.	3.5	5
5. Data sources for NCD (day 2) Identify the advantages and disadvantages of using different data sources for NCD surveillance; recommend data sources for a particular surveillance project.	3.5	5
6. Descriptive and analytical studies (day 3) Identify the type of study to conduct (descriptive or analytic, case-control or cohort); identify what data to collect for a specific study; identify the appropriate data sources and sampling method to use for a specific study.	3	5
7. Analyze and interpret surveillance data (day 3) Determine the categories and specific data within each category to collect for a surveillance system; describe the analytical approach to use to address a surveillance system objective; identify limitations of surveillance data; interpret surveillance data, including trends and patterns; describe public health recommendations that relate to surveillance objectives.	3	5
8. Epi info (days 4 and 5) Enter data; create/recode variables; perform descriptive statistics; trouble shoot errors.	2	5
9. Using Excel to create graphs (days 5) Create a surveillance data table; create histograms; line graphs; stacked bar graphs.	3	5
10. Data dissemination (day 6) Describe a message to disseminate; describe the objective of the message to disseminate and target audience for data dissemination; identify the communication medium to use for data dissemination; identify how to evaluate the impact of the dissemination.	3	5
11. NCD prevention and control (day 6) Determine how your country's current system can be adapted to address NCD prevention and control in the short, medium and long term; identify challenges to NCD prevention and control and how to overcome them.	3	5
12. Planning programs and work plans (day 7) Develop a health problem statement; develop a health program goal; develop short-term objectives; write a process objective; list resources needed for the health program; identify cultural norms and behaviors that may impact the health issue; describe and address at least two barriers to program implementation; develop a communications plan for program planning; develop a schedule.	2	4.5
13. Evaluating programs (day 8) Use the CDC evaluation framework; identify the stakeholders to involve; create a logic model; develop process and outcome evaluation questions; describe feasible and meaningful recommendations for action; describe how to effectively communicate findings and recommendations; determine how you will achieve the evaluation standards.	2	4
14. Evaluating surveillance systems (day 9) Recognize the six evaluation steps; determine whether all the components of an evaluation report are included; determine how the system attributes are described. Make recommendations for use of evaluation findings.	2	4

Total n varied from 7–16 for each competency assessed due to missing data. A small percentage the evaluations had greater than 14 responses because completed by 'observers'.

DALYs: disability-adjusted life years; NCD: non-communicable diseases; QALYs: quality-adjusted life years.

^a Responses are retrospective self-reported evaluations reported after completing each module. Not all 88 competencies are shown.

projects outcomes and improvement in the trainees' performance; used to measure behavior and results. Learning and behavior were also evaluated based on anecdotal comments from the facilitators, the coordinator and the CDC mentors. All evaluation forms were anonymous. The retrospective assessment of change in perceived competence level was used as it is recommended for avoiding 'response shift bias', which occurs when students inaccurately self-report their pre-test scores or skills because of their internal reference of knowledge and skills.^{29,30}

Analysis

Change in knowledge and self-reported competence were assessed using Wilcoxon sign-rank tests, which is a more valid approach for comparing change in scores when dealing with small sample sizes; this test uses median scores instead of mean scores. For simplicity of reporting, the competencies were grouped based on module, with the most common self-reported pre-post competence level presented (Table 1). Quantitative data were summarized using descriptive statistics. Qualitative data from open-ended questions and discussions with facilitators, CDC mentors and the coordinator were noted. A deductive approach was used to group the qualitative data from these open-ended questions and discussions; similarities and differences between the responses were noted and a few individual comments are presented verbatim in this paper. Analyses for the quantitative data were computed using Epi Info version 3.5.1 and STATA 11.0 (StrataCorp, College Station, TX, USA) software. Because of the small sample size, no software was used to group or analyze the qualitative data. Data collected were kept confidential and stored in a locked cabinet on CDC property in Atlanta. The evaluation was considered 'exempt' from CDC's Institutional Review Board.

Results

Trainees

Fourteen trainees attended the first day of the course. Of these, 11 were employed by the Tanzania MOH either at the national (Dar es Salaam) or district (Morogoro, Dodoma, Pwani, and Zanzibar) levels; three worked for the public health systems in Rwanda, Botswana or Kenya. Nine of the 14 trainees reported being medical officers or physicians; others were health clinic officers or epidemiologists, with undergraduate backgrounds in the health or medical sciences. All 14 trainees reported prior training in epidemiology and public health promotion, but mainly in the context of communicable diseases; nine reported no prior training on NCD prevention and control. One of the 14 trainees did not complete the course because he/she had to leave in the first week due to an emergency. A few trainees reported previous work experience in programs or projects related to NCD topics. In addition to the 14 trainees, four MOH workers from Dar es Salaam or Zanzibar, with similar educational background and career level, attended a few lessons as observers.

Reaction and learning

All 13 trainees completing the course reported that the course was well organized; the directions given were clear; the skills learned would be used in their jobs; the course kept their interest;

useful materials for reference in the future were provided and the course met their expectations (data not shown). Of these 13 trainees, 12 reported the course to be at the right level for them and 9 reported desiring more time to complete the lesson objectives and practice exercises. The modules most liked by trainees were Epi Info, planning programs and evaluating programs; these modules were also reported as most difficult (data not shown).

Among the 13 trainees, mean knowledge (based on a 0–100 scale) increased significantly from 65.7 to 80.0 ($p < 0.05$) (data not shown). Most trainees reported a '2' (not very confident) or '3' (somewhat confident) as their pre-lesson competence level and a '4' (very confident) or '5' (completely confident) at the post-lesson competence level (Table 1). Significant improvements in all self-reported competencies were detected, except for 'using the frequency command on Epi Info' ($p = 0.062$) and 'recognizing the six evaluation steps' ($p = 0.104$) (data not shown). The facilitators also reported successful completion of practice exercises.

Behavior and results

Six one-person projects were completed and presented (Table 2). All six projects were well presented, and the NCD mentors and training coordinator noted successful application of relevant NCD competencies taught during the course (qualitative data). One project resulted in diabetes clinic staffing changes and diabetes educational program initiation and another project led to the initiation of an injury surveillance system (Table 2). Course observers reported conducting a community needs assessment, collecting local NCD data and prioritization community NCD activities (Table 2).

Among the five trainees who completed the 8-month evaluation form, the modules reported most often used in day-to-day work activities were using excel to create charts, NCD epidemiology, NCD prevention and control and prioritizing public health (Table 3). The three supervisors who attended the presentations reported improvements in the trainees' performance as a result of the training, and being satisfied with the outcomes (qualitative data). Trainees with field projects reported enjoying the field project experience and being satisfied with the outcomes (qualitative data). Trainees reported changing their work practices as a result of the training (Table 4). Factors most often noted by the trainees as helpful for ensuring application of skills included encouragement/support, mentoring/training from the supervisor and their belief that the training would improve their work performance (Table 4). Because trainees completing field projects resided in or near Dar es Salaam, they reported frequent in-person interaction with the training coordinator and the TFELTP staff and reported this as helpful (qualitative data). Trainees reported that lack of time made conducting the field projects difficult. Trainees and supervisors recommended additional NCD trainings and financial resources for NCD activities (Table 4).

Discussion

An applied NCD epidemiology and control training for public health workers of LMICs was piloted in Tanzania in 2011 and evaluated using Kirkpatrick's²⁵ model for effective trainings. This training received positive reaction and showed evidence of learning. Although changes in workplace behavior and results (organizational policies and activities) were evident, our assessment of

Table 2. Field projects completed from July 2011-January 2012 and their respective results (NCD institutional/workplace policies and activities)

1. Title: Characterization of patients with type 2 diabetes in a local hospital
Purpose: Identify risk factors and comorbidities related to type 2 diabetes in local hospital
Result: None reported at time of presentation. Project report was to be presented to senior management.
 2. Title: Description of diabetes complications in a local hospital
Purpose: Identify most common complications associated with diabetes in local hospital
Result: Project findings created institutional awareness and resulted in an increase in diabetes clinic staff; increase in education on diet, exercise, drug compliance; increase in clinic days allocated to diabetes patients.
 3. Title: Description of road traffic accidents injuries in a local hospital
Purpose: Identify frequency and type of road traffic injuries reported in local hospital
Result: The project findings were presented to senior level staff and contributed to increased awareness of injuries and successful institutional and financial support to initiate an injury surveillance system. Knowledge gained in NCD epidemiology resulted in trainee contributing to NCD activities initiated by 'observers' (see below).
 4. Title: Burden of road traffic accidents reported to a police station
Purpose: Identify frequency and type of road traffic injuries reported to police station
Result: First time data from police records used for public health purposes; data were to be utilized to advocate driving-related policies.
 5. Title: Evaluation of nutrition components of an existing national surveillance system
Purpose: Assess the need for greater nutritional coverage in the surveillance system
Result: None reported at time of presentation. Project report was to be presented to senior management.
 6. Title: Burden of cardiovascular disease and related complications in a local hospital
Purpose: Identify prevalence of cardiovascular disease and complications in local hospital
Result: Recommendations given to hospital management and staff to improve NCD registries and data storage/management.
- NCD activities (results) initiated by two course 'observers' who worked together (one the supervisor of the other):
- A community needs assessment conducted that included various levels of government and healthcare.
 - Collection of local surveillance NCD data.
 - Prioritizing of NCD public health activities within the community.

NCD: non-communicable diseases.

these was limited to the small sample of trainees completing field projects and follow-up evaluations. Furthermore, because the development, approval and implementation of institutional/organizational activities and policies can take several months or years, it is possible that not all potential 'results' were captured.

Several lessons were identified in this pilot that should be considered in future trainings. First, to ensure learning, courses should include ample time for practice exercises and discussions, particularly when teaching new or complex topics such as Epi info, evaluating programs and planning programs. This additional time for practice exercises could be considered homework during the training or could be added to the training course as additional distance-based learning (e.g., web-based modules). Second, trainees need dedicated work-time and workplace/supervisor support to be able to practice skills at work and conduct field projects. Our findings are consistent with those from training of Ethiopian public health workers.¹² Workplace and supervisor support, which can lead to more dedicated work time, could be increased by briefing supervisors and workplace institutions about the purpose of the training and field projects. It may also be helpful to have the supervisor and trainee agree on an amount of time per day or week to be devoted to the field projects, which we did not do in our training. For the supervisor to have greater understanding of how trainee's NCD skills can be applied at work, it may help for the supervisor to attend the presentation day and/or a few modules/sessions. Third,

following up with trainees will likely be challenging, which could be why many trainings only evaluate reaction and learning.^{31,32} We found that having an in-country coordinator and in-person communication helped with engagement and communication. Thus, having an in-country training coordinator that could personally visit trainees may help with follow-ups. For trainers to have a better understanding of workplace changes as a result of the training, it may help to have periodic phone calls with the trainees' supervisors; this may increase supervisor/workplace support.

Our experiences in Tanzania agree with what the literature on trainings for public health workers suggest, that mentoring and supervisor support (e.g., approval, assistance, workplace time)^{12,24,31,33-34} and in-country and institutional support (e.g., resources and workplace time)^{10,11,31,35} are factors that affect the effectiveness of training and are critical for building capacity and ensuring sustainability. In our case, we found it beneficial to have a pool of in-country faculty/staff and graduates of the first training for implementing and facilitating the second training in Tanzania. This second training was conducted in 2012 among a new cohort of public health professionals and mainly supported by in-country resources. We believe that most trainings of this length and size would require about four to five instructors; this would allow a better instructor to trainee ratio.

The NCD modules presented in this paper, except the Epi info and Excel tutorials, became 'public use' in November 2013 and are

Table 3. Number of trainees^a reporting modules to be relevant to work and frequency of use

Relevant to work Module	How often used at work		How often used at work			
	Yes	No	Always	Sometimes	Rarely	Never
NCD epidemiology	5	0	4	1	0	0
NCD burden of disease	3	2	3	2	0	0
Prioritizing public health problems	5	0	4	1	0	0
NCD surveillance	4	1	2	2	0	1
Data sources for NCD	5	0	2	3	0	0
Descriptive and analytical studies	4	1	1	1	3	0
Analysis and interpretation of surveillance data	4	1	2	3	0	0
Epi info	5	0	3	2	0	0
Using Excel to create charts	5	0	5	0	0	0
Data dissemination	3	2	2	2	0	1
NCD prevention and control	3	2	4	1	0	0
Planning programs and work plans	4	1	2	1	0	1
Evaluating programs	4	1	1	3	0	1
Evaluating surveillance systems	5	0	2	2	0	1

NCD: non-communicable diseases.

^a Responses were from the five trainees with field projects who completed the 8-month evaluations. One of the six trainees with field projects had to leave after his/her presentation and therefore did not complete the 8-month evaluation form.

Table 4. Workplace behaviors, supportive factors and recommendations^a from trainees

Workplace behaviors: Please answer (Yes/No) the following: (n=trainees reporting 'yes')

n=5 Have you made any changes to your workplace practices as a result of the training?

n=5 Have you had the opportunity to share your learned skills with colleagues?

n=3 Have you suggested workplace practices/policies as a result of the training?

n=5 Did the training make accomplishing your job tasks easier or more interesting?

Workplace support: Please answer (Yes/No) the following: (n=trainees reporting 'yes')

n=5 Do you feel your work organization/institution benefited from this training?

n=5 Did you receive workplace support to use the skills gained?

n=4 Did you have any workplace obstacles that prevented you from using the skills gained?

n=5 Do you think your supervisor values the training you received?

Other supportive factors: If you have been able to apply the knowledge and skills you learned, which of the following factors helped you?

(check all that apply): (n=trainees checking the item)

n=4 Mentoring/training from my supervisor

n=4 Support and/or encouragement

n=3 Effective system of accountability or monitoring

n=5 Belief that it would help me to be more effective in my work

n=2 Ongoing training I have received after the initial class

n=1 Payment or bonus for applying the knowledge

Recommendations: What could be done differently to this training to enhance skills gained?

- 'increase mentoring and local communication' (trainee)
- 'increase training frequency (offer more trainings)' (trainee) (supervisor)
- 'teach how to deal with missing data' (trainee)
- 'financial support for conducting studies and preparing education materials' (trainee)
- 'tools and other resources in the working places are needed' (supervisor)
- 'offer training to other health field professionals (e.g., nurses)' (supervisor)

^a Responses were from the five trainees with field projects who completed the 8-month evaluations; three of the supervisors attending the field project presentations also provided recommendations. Supervisors attending the presentation had trainees with 'notable' results. Parenthesis next to recommendations show who provided the recommendation.

available at CDC's FETP website.²⁷ Field projects and Epi info/Excel tutorials are recommended additional components to NCD trainings. Financial resources for field projects, for example through small grants, should be sought in advance to ensure field projects are conducted.

Limitations in the training's evaluation should be noted. The sample was small and data were based on self-report. Trainees did not submit all of the evaluation forms, perhaps due to lack of time or understanding of its value. Trainee feedback about the training's impact was limited to those completing field projects, while supervisor feedback was limited to those attending the presentations. It is possible that not enough time lapsed to detect changes in trainees' workplace behaviors and training results.³⁰ Trainees might not be representative of other public health workers in Tanzania and findings may not be generalizable to other countries.

Conclusions

The applied NCD epidemiology and control training piloted in Tanzania received favorable reviews and showed promise for providing the knowledge, skill and self-efficacy necessary for initiating or improving NCD workplace practices in LMICs. Comprehensive evaluations with longer follow-up periods are needed to better understand whether applied NCD trainings to improve workplace behaviors and produce institutional/organizational results. The success of future NCD trainings in LMICs may depend on in-country technical support, mentoring, the trainees' workload and workplace support.

Authors' contributions: EPD led the training's evaluation, the data analyses, the interpretation of findings and manuscript writing; ZS coordinated the training and evaluation activities; IR and JM led the design and implementation of the training; AB led the curriculum development and the training of facilitators/instructors; EPD, IR, JM, IA, MC, SCZ and MK were facilitators/instructors of the training; EPD and IR served as project mentors; PM, BJ, MC, MK, SCZ, IA, AB, ZS and EPD contributed to the training's conception, design and/or implementation; ZS, JM, IR, IA, MC, AB, SCZ and MK contributed to the training's evaluation. All authors contributed to the interpretation of findings and/or the manuscript writing. All authors read and approved the final manuscript. EPD is the guarantor of the paper.

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Competing interests: None declared.

Ethical approval: This study was approved and considered exempt by CDC's Internal Review Board.

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