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Evaluation of a Training Intervention for Couples' HIV Counseling and Testing Counselors in Copperbelt Province, Zambia

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An abstract of
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Abstract

Evaluation of a Training Intervention for Couples' HIV Counseling and Testing Counselors in Copperbelt Province, Zambia
By Kathleen Y. Wu

With the expansion of couples' voluntary HIV counseling and testing (CVCT) in urban Zambia, there has been a growing need to evaluate CVCT trainings to ensure that couples are receiving quality counseling and care. Zambia-Emory HIV Research Project (ZEHRP) has been providing CVCT counseling, laboratory testing, and data management trainings in the Copperbelt Province since 2008. The objective of this study was to answer two questions regarding the CVCT trainings held by ZEHRP: (1) Were the training programs successful in improving knowledge of relevant facts and procedures? (2) Was the knowledge among non-medical "lay" counselors comparable to that of medically trained counselors before and after the trainings? This study evaluated 1,283 counselors, rapid HIV testing staff ("laboratory"), and data managers. Each of the trainings was quantitatively measured in a pre-post test design based mainly on true/false questions. The tests covered topics including the cause of HIV infection, modes of transmission, the basics of couples' counseling, and the counseling of discordant results. Following training, the overall average score increased from 68.8% at baseline to 83.8% ($p < 0.001$). Average scores across covariates, including years of experience, education, and medical background also resulted in statistically significant improvement during the post-test ($p < 0.001$). 98.4% of data management and laboratory testing trainees passed their post-training test with at least an 80%. In contrast, the average post-training score for counselor trainees was below 80% in some groups including men, those over the age of 50, those trained before 2011, and those with less than a college education or a non-medical background. Counselors in two of the four cities had average post training scores greater than 80%. Most of these factors remained predictive of post-test scores in multivariate analyses, with significant interactions occurring between several variables. Systematic pre and post-test assessments are critical to ensure quality services and to highlight training components that must be repeated until passing scores are achieved, particularly as task-shifting from medical to lay staff becomes more common.

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Kathleen Y. Wu

ABSTRACT

With the expansion of couples' voluntary HIV counseling and testing (CVCT) in urban Zambia, there has been a growing need to evaluate CVCT trainings to ensure that couples are receiving quality counseling and care. Zambia-Emory HIV Research Project (ZEHRP) has been providing CVCT counseling, laboratory testing, and data management trainings in the Copperbelt Province since 2008. The objective of this study was to answer two questions regarding the CVCT trainings held by ZEHRP: (1) Were the training programs successful in improving knowledge of relevant facts and procedures? (2) Was the knowledge among non-medical "lay" counselors comparable to that of medically trained counselors before and after the trainings? This study evaluated 1,283 counselors, rapid HIV testing staff ("laboratory"), and data managers. Each of the trainings was quantitatively measured in a pre-post test design based mainly on true/false questions. The tests covered topics including the cause of HIV infection, modes of transmission, the basics of couples' counseling, and the counseling of discordant results. Following training, the overall average score increased from 68.8% at baseline to 83.8% ($p < 0.001$). Average scores across covariates, including years of experience, education, and medical background also resulted in statistically significant improvement during the post-test ($p < 0.001$). 98.4% of data management and laboratory testing trainees passed their post-training test with at least an 80%. In contrast, the average post-training score for counselor trainees was below 80% in some groups including men, those over the age of 50, those trained before 2011, and those with less than a college education or a non-medical background. Counselors in two of the four cities had average post training scores greater than 80%. Most of these factors remained predictive of post-test scores in multivariate analyses, with significant interactions occurring between several variables. Systematic pre and post-test assessments are critical to ensure quality services and to highlight training components that must be repeated until passing scores are achieved, particularly as task-shifting from medical to lay staff becomes more common.

INTRODUCTION

Two-thirds of individuals living with HIV reside in sub-Saharan Africa, with the highest incidence occurring in cohabiting heterosexual couples (1). It is estimated that the majority of new HIV infections in urban Zambia – 99% among married women and 87% among married men – are attributable to a lack of awareness of being 'discordant,' in which one partner is HIV-negative and the other is HIV-positive (2, 3). This poses a significant concern as three-quarters of adults aged 20 to 49 are in cohabiting unions and among married couples, more than 90% of reported sexual contacts are with their spouse (4).

The introduction of couples' HIV counseling and testing (CVCT) has been estimated to reduce transmission in discordant couples by one-half to two-thirds and to reduce sexually transmitted infections, unplanned pregnancies, and reported extramarital partners in all couples (2). Couples' testing also plays an important role in HIV prevention by educating couples as a unit and providing the necessary support during the discovery of each partner's HIV status (5). In 2007, the importance of CVCT was recognized with the development of *The Couples HIV Counseling and Testing Intervention and Training Curriculum*, a joint collaboration between the Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), Zambia-Emory HIV Research Project (ZEHRP), and the Liverpool School of Tropical Medicine (6). The CVCT training curriculum was also fully endorsed by the Zambian Ministry of Health (MoH) in 2008.

However, implementation and expansion of couples' HIV counseling and testing within Zambia has faced infrastructural obstacles. CVCT entails specialized training that utilizes prevention and support messages in the context of the couple instead of the individual (7, 8). Unfortunately, many African countries, including Zambia, have been experiencing a shortage of health care providers. One solution has been to task-shift HIV counseling roles to non-medical staff, commonly known as "lay counselors" (8, 9, 10, 11, 12).

Earlier evaluations have demonstrated that didactic training programs can significantly improve health care providers' knowledge of HIV and improve the quality of care provided to HIV patients (8, 13, 14). The purpose of this study is to evaluate the training programs provided by ZEHRP in four cities in the Copperbelt Province, reaching 1200 trainees. The study addresses two questions: (1) Were the training programs successful in improving knowledge of relevant facts and procedures?, and (2) Was the knowledge among non-medical "lay" counselors comparable to that of medically trained counselors before and after the trainings?

Program background

The Zambia-Emory HIV Research Project has been providing CVCT training and counseling services in Lusaka, Zambia since 1994. In 2010, with funding from the Canadian International Development Agency (CIDA) through the Arise program overseen by the Program in Appropriate Technology in Health (PATH), ZEHRP expanded its CVCT training programs to more than 50 government clinics within the densely populated Copperbelt mining province. The goal of the expansion was to strengthen CVCT as a prevention strategy.

ZEHRP has worked with the Zambian Ministry of Health and local District Health Offices to conduct CVCT training sessions beginning as early as 2008 within the Copperbelt Province (15, 16, 17). In the course of assisting government clinics in the Copperbelt cities with the establishment of CVCT services, ZEHRP has also implemented a comprehensive training program including pre and post-training didactic examinations. The trainings are provided by senior ZEHRP counselors, who are fluent in both English and Bemba, the local dialect. The CVCT curriculum includes the following modules: (1) Background and HIV discordance (2) Introduction to couples' counseling skills (3) Initial session of the CVCT intervention (4) Providing concordant negative results (5) Providing concordant positive results (6) Providing discordant results (7) Support and prevention results and (8) Outreach and recruitment (http://www.cdc.gov/globalaids/resources/prevention/CVCT.html). The counselors are also

provided with role playing activities based on realistic clinic scenarios. A written exam is administered before and after didactic training. Trainees achieving at least an 80% on the post-test proceed to practicums in the government clinics, with certification given when competency is demonstrated.

Additional training in data management and laboratory testing are offered to those who have successfully completed CVCT training and have demonstrated a solid work performance as an HIV counselor. The laboratory trainings also require previous certification in the HIV algorithm training provided by the MoH. Modules for these trainings include good clinical laboratory practices, CVCT laboratory testing, and good data practice and quality control.

METHODS

The study evaluated a total of 1,283 trainees selected from 67 government clinics in four cities (Ndola, Kitwe, Chingola, and Luanshya) between 2008 and 2013.

Survey

For each of the three trainings, the pre-test was given immediately before commencing the first day of training and the post-test was provided at the conclusion of the didactic program (3 days for couples' counseling, and one day each for data management and rapid HIV laboratory testing). Participants had 15 minutes to answer the test questions during both the pre and post-test sessions. For the CVCT counselor training, the test was organized into 10 true/false questions and one open-ended question that tested the counselor's ability to explain a discordant result to the couple. The true/false section covered the main topics in the training modules, including the cause of HIV infection, modes of transmission, the basics of couples' counseling, and the counseling of discordant results. The data management pre-post tests also consisted of 10 true/false questions and covered additional topics on monitoring & evaluation and quality control of the data collection process.

The laboratory training evaluation was more technical, with 8 true/false questions measuring the ability to differentiate between VCT and CVCT testing algorithms (18), specific characteristics of each test kit, correct procedures for initial and follow-up testing, and to identify the correct actions following the detection of an indeterminate or discrepant result. A multiple choice question on how to prevent testing errors was also included.

All pre and post-tests were identical in order to ensure that no factors other than the intervention would have an impact on the test scores. The scores were calculated as a percentage of the correct answers, with each question weighted equally.

Analysis

The data were collected in Microsoft Access following each training workshop and were cleaned and analyzed retrospectively using SAS 9.0 (19). For the purposes of this study, some of the covariates were re-coded and simplified into two or three categories. Participants were divided into three levels of education (i.e. less than high school, high school, and college). Trainings by year were also categorized to make the results of the analysis more meaningful because 2008, 2009, and 2013 had a small number of participants. In addition, job occupations were coded into a bivariate parameter that classified participants as either medical professionals or non-medical personnel. Medical professionals included nurses (equivalent to a licensed practical nurse, registered nurse, or Bachelors' level nurse in the US), midwives, clinical officers, clinical coordinators, and laboratory technicians. The non-medical personnel included participants who were working as lay counselors, psychosocial counselors, social workers, and community health workers.

Descriptive statistics were assessed, including age, gender, years of experience, level of education, and previous medical knowledge. Bivariate analyses using paired t-tests and linear regressions were used to evaluate the relationship between the pre and post-test scores. An analysis of covariance (ANCOVA) was also used to assess both the pre and post-test, while adjusting for the other parameters of interest. A significance level of $p < 0.05$ was used for all analyses.

RESULTS

Baseline characteristics

Demographic descriptors for the trainees are presented in Table 1. Overall, 423 counselors, 398 laboratory technicians, and 434 data managers were trained by ZEHRP from 2008 until 2013, with the majority being trained in 2011. The median age for participants was 44 years (range: 21-71) and half of the trainees had at least 5 years of experience in HIV counseling (range: 0-35). Fifty-nine percent (751) of the participants had received a high school education, while another thirty percent (384) had attended college. Eighty percent (1,030) of the trainees were women and seventy percent (849) had a medical background. For the counseling, laboratory testing, and data management trainings, 56% (233), 78% (337), and 76% (279) of the participants were medical professionals respectively.

Impact of the training

Paired t-test comparisons of pre and post-training test results are shown for the group as a whole in Table 2, and stratified by training type in Table 3. Multivariate analyses of predictors of pre and post-test scores are shown in Table 4.

Of the total number of participants (n = 1,283), 1,226 individuals completed both the pre and post-test evaluation (Table 2). Both the overall average test score as well as the scores within each parameter of interest demonstrated statistically significant improvement following training ($p < 0.001$). At baseline, the mean score for all training types was 68.8%, with a mean of 58.2% for counseling, 74.6% for laboratory testing, and 76.6% for data management. Following the training intervention, the overall average score in the post-test evaluation increased to 83.8%, a difference of 15 percentage points from the baseline score. The averages within the three training types also improved to 79.6% for counseling, 87.2% for data management, and 86.1% for laboratory testing, a difference of 21.4, 10.6, and 11.5 percentage points respectively (Table 2). 98.4% of the data management and laboratory testing trainees passed their post-training test with

at least an 80%. In contrast, counselors had an average post-training score just below the minimum requirement of 80%. Women and men had similar pre-training scores, but women showed more improvement than men following the intervention. Post-training scores were less than the minimum requirement of 80% for the few trainees with less than a high school education, trainees with no medical background, and those trained in 2010 or earlier.

A paired t-test analysis assessing the effect of the intervention stratified by training type also found statistically significant increases in test scores observed in most demographic and geographic groups ($p < 0.0001$, Table 3). Among the counseling and data management trainees, only the 9 without a high school education did not pass their post-training test, and trainees in 2012-2013 scored an average of 79.5%. Among laboratory trainees, all groups had passing average post-training scores with the exception of 9 trainees from Luanshya. Trainees with a medical background had substantially higher pre and post-training scores than non-medical personnel in the data management trainings but differences were minimal in the laboratory trainings.

In contrast, counseling training was less successful overall, with many groups having post-training scores below 80% (Table 3) Women counselors had higher scores than men for both the pre and post-tests (women: pre = 59.0%, post = 80.7%; men: pre = 55.0%, post = 74.6%). Counselor trainees over the age of 50, those with less than a college education or a non-medical background, those from Ndola or Chingola, and those trained in 2010 or earlier had average post-training scores below the minimum 80%. In addition, counselor trainees with a medical background had substantially higher pre and post-training scores than non-medical personnel.

An evaluation of the average test scores in the four cities and by training year found no consistent patterns. Overall, counselors in two of the four cities had average post training scores greater than 80%, whereas data management and laboratory testing trainees had a score higher than 80% in all cities with the exception of Luanshya for laboratory testing (74.4%). Luanshya also had the lowest average laboratory testing pre-test score (60.3%), but had the highest

counseling pre and post-test scores of the 4 cities. On the whole, Luanshya showed the greatest improvement by city with an overall 17.1 percentage point increase from 69.4% at baseline to 86.4% in the post-training test. In contrast, Chingola had the lowest pre and post-test scores for both counseling (52.4% and 75.3%, respectively) and data management (68.8% and 81.3%, respectively) trainings.

Multivariate analyses also showed that having a medical background, receiving data management or counseling trainings, and receiving training during 2011 remained predictive of higher test scores both pre and post training (Table 4). Pre-test scores for high school ($\beta = 10.1$, $t = 2.06$, $p = 0.040$) and college ($\beta = 16.7$, $t = 3.38$, $p < 0.001$) educated participants were significantly higher compared to those who received less than a high school education (*ref*). However, even though there was still a positive correlation between education level and average test scores after the training, the difference was not statistically significant in the multivariate model (*ref* = less than high school, high school $p = 0.202$, college $p = 0.468$). Age and years of experience were collinear, and both parameters were not independently predictive in either the pre or post-test ANCOVA analyses (age: pre $p = 0.906$, post $p = 0.728$; years of experience: pre $p = 0.190$, post $p = 0.145$). Gender was also not predictive of either the pre or post-test scores (pre $p = 0.779$, post $p = 0.180$).

Significant interactions between covariates were also observed in the multivariate analyses. For both the pre and post-test multivariate analyses, the city parameter had significant interactions with both training year and training type (Appendix A, Appendix B). Additional interaction terms were noted in the post-test ANCOVA, including age with both education and gender, pre-test score with medical knowledge, and training year with education, training type, and years of experience.

DISCUSSION

As demonstrated in the pre-post analyses, using standardized didactic materials to prepare counselors for all aspects of couples' HIV counseling and testing is a highly effective training method. Overall knowledge of CVCT at baseline was below an acceptable passing score. Though pre-test scores were significantly impacted by factors such as level of education and medical background, significant improvement in test score averages was noted in all educational groups. In addition, while educational level was predictive of pre-training test scores, the covariate did not remain a significant predictor during post-test analysis. Average post-test scores were also above the minimum passing grade of 80% for data management and laboratory training, and 79.6% for counseling. The main contributor to sub-standard post-test counseling scores were trainees with no medical background, who often required booster counseling training to achieve a passing score. With the shortage of human medical resources in Zambia, CVCT has been delegated to lay counselors, and while the quality of CVCT can be maintained, it is essential to also quantitatively assess the success of training and to provide booster trainings as needed. The consistently higher scores seen with medical professionals suggests that limiting the roles of trainers, or trainers of trainers, to medical staff would also be more likely to result in high quality services. Key predictors of higher pre-test scores in the multivariate analysis included higher education, being trained prior to 2012, and having a medical background. Years of experience, age, and gender did not have a significant impact on either the pre or post-test scores in the multivariate analyses.

Strengths and limitations

The study was based over a six year period and included a total of 1,283 participants. The large cohort allowed for stratification during analysis, while still maintaining good precision and adequate sample sizes within most subgroups. Using the same test questions on both the pre and post-test also allowed for a more accurate evaluation of the training intervention by ensuring that

a participant's CVCT knowledge could not be influenced by factors including question or wording changes. Moreover, this design permitted the use of a paired t-test, which essentially controlled for any outside variability during the analysis by matching the baseline and post-test scores of each participant.

Conversely, there were also several limitations due to both the design of the study and the inherent construction of the evaluation tool. Since the pre and post-test questionnaires were based on true/false questions that were provided within three days of one another, this posed a threat to internal validity. Specifically, the short duration of time between the pre and post-tests could lead to higher test scores in the post-test because of familiarity with the questions.

The retrospective nature of the study was also a significant limitation, as there was the potential for processing errors including data entry and transcription errors. Additional information was also omitted during the re-coding and categorization of certain parameters such as educational level. Furthermore, the use of the ZEHRP database prevented any evaluation of specific topics or questions within the pre and post-test questionnaires, because only the percentage of correct answers was entered into the database. There was also no data available for the open-ended counselor test question or for the number of HIV-related trainings each of the participants may have previously attended. Lastly, although the study indicates the benefit of using the ZEHRP training method to improve knowledge of CVCT in Zambia, the results may not be generalizable to other fields or regions.

CONCLUSION

The study found that the Zambia-Emory HIV Research Project training curriculum was highly effective in improving the participants' knowledge of couples' HIV counseling and testing content and procedures. Trainees exhibited significantly higher test scores following the intervention, with the exception of the few trainees that did not have at least a high school education. The findings confirm that the training curriculum can help close the knowledge gap between medical professionals and non-medical personnel. This supports the Ministry of Health's decision to task-shift certain counseling roles to the lay counselors in order to address the shortage of health care providers. Systematic pre and post-test assessments are critical to ensure quality services and to highlight training components that must be repeated until passing scores are achieved.

REFERENCES

1. UNAIDS. 2008 Report on the Global AIDS epidemic. Geneva: Joint United Nations Programme on HIV/AIDS. 2008.
2. Dunkle KL, Stephenson R, et al. New heterosexually transmitted HIV infections in married or cohabiting couples in urban Zambia and Rwanda: an analysis of survey and clinical data. *Lancet* 2008:371; 2183-2191.
3. Lingappa J, Lambdin B, et al. Regional Differences in Prevalence of HIV-1 Discordance in Africa and Enrollment of HIV-1 Discordant Couples into an HIV-1 Prevention Trial. *PloS One* 2008:1; e1411
4. Allen S, Meinzen-Derr J, et al. Sexual behavior of HIV discordant couples after HIV counseling and testing. *AIDS* 2003: 17; 733-750
5. Kurth AE, Celum C, Baeten JM, Vermund SH, and Wasserheit JN. Combination HIV Prevention: Significance, Challenges, and Opportunities. *Curr HIV/AIDS Rep.* 2011:8(1); 62-72.
6. CDC. Couples HIV Counseling and Testing Interventions and Curriculum. Atlanta, GA, USA: CDC. 2007.
7. Chomba E, Allen S, Kanweka W, Tichacek A, Cox G, Shutes E, et al. Evolution of Couples' Voluntary Counseling and Testing for HIV in Lusaka, Zambia. *J Acquir Immune Defic Syndr* 2008:47(1); 108-115.
8. Lehmann U, Van Damme W, Barton F, and Sanders D. Task shifting: the answer to the human resources crisis in Africa? *Human Resources for Health* 2009: 7(49); doi:10.1186/1478-4491-7-49.
9. Morris MB, Chapula BT, Chi BT, Mwango A, Chi HF, Mwanza J, et al. Use of task-shifting to rapidly scale-up HIV treatment services: experiences from Lusaka, Zambia. *BMC Health Services Research* 2009:9(5); doi:10.1186/1472-6963-9-5.

10. Sanjana P, Torpey K, Schwarzwalder A, Simumba C, Kasonde P, Lameck N, et al. Task-shifting HIV counselling and testing services in Zambia: the role of lay counsellors. *Human Resources for Health* 2009: 7(44); doi:10.1186/1478-4491-7-44.
11. Walsh A, Ndubani P, Simbaya J, Dicker P, and Brugha R. Task sharing in Zambia: HIV service scale-up compounds the human resource crisis. *BMC Health Services Research* 2010:10(272); doi:10.1186/1472-6963-10-272
12. Msisuka C, Nozaki I, Kakimoto K, Seko M, Ulaya MMS, and Syakantu G. An evaluation of a refresher training intervention for HIV lay counsellors in Chongwe District, Zambia. *J Social Aspects of HIV/AIDS* 2011:8(4); 204-209.
13. Kamiru HM, Ross MW, Bartholomew LK, McCurdy SA, and Kline MW. Effectiveness of a training program to increase the capacity of health care providers to provide HIV/AIDS care and treatment in Swaziland. *AIDS Care* 2009:21(11); 1463-1470.
14. Chao LW, Gow J, Akintola O, and Pauly M. A Comparative Evaluation of Two Interventions for Educator Training in HIV/AIDS in South Africa. *J Educ Dev Using Inf Commun Technol*. 2010:6(1); 1-14.
15. Lambdin BH, Kanweka W, Inambao M, et al. Local Residents Trained As 'Influence Agents' Most Effective In Persuading African Couples On HIV Counseling And Testing. *Health Affairs* 2011;30(8):1488-97.
16. Sitrin D, Clements A, Mwananyanda L, Kilembe W, Kautzman M, Conkling M, et al. Using referrals from government health centers to expand an HIV discordant couple cohort in Lusaka, Zambia in preparation for vaccine efficacy trials. *Retrovirology* 2009:6(3); P93.
17. Ahmed N, Inambao M, Siangonya B, Kaster R, Lewinski J, Davitte J, et al. Capacity building of government and copper mining healthcare providers for rapid expansion of couples voluntary HIV counseling and testing in Zambia's Copperbelt Province. *International AIDS Society* 2012: Abstract.

18. Manigart O, Boeras DI, Karita E, et al. A gp41-Based Heteroduplex Mobility Assay Provides Rapid and Accurate Assessment of Intrasubtype Epidemiological Linkage in HIV Type 1 Heterosexual Transmission Pairs. *Aids Research and Human Retroviruses* 2012;28(12):1745-55.

19. SAS Institute, Inc. 1976. *(Version 9.0)* [Computer Software] Cary, NC.

TABLE 1. Descriptive statistics of the participants

Characteristic (n = 1283)		
Median post-test (n = 1249)	87	
Median pre-test (n = 1260)	70	
Male, *n (%)*	253	(19.7)
Median age (n = 1282)	44	
Median years of experience (n = 1147)	5	
Education		
Less than high school	21	(1.7)
High school	751	(59.0)
College or university	384	(30.2)
Unknown	116	(9.1)
City, *n (%)*		
Ndola	524	(42.1)
Kitwe	369	(29.7)
Chingola	236	(19.0)
Luanshya	115	(9.2)
Medical Knowledge, *n (%)*		
Non-medical background	366	(30.1)
Medical professional	849	(69.9)
Training Type, *n (%)*		
Counseling	423	(33.7)
Laboratory testing	398	(31.7)
Data management	434	(34.6)
Training Year, *n (%)*		
2010 and earlier	141	(11.0)
2011	748	(58.3)
2012 and later	394	(30.7)

TABLE 2. Effect of training on test scores using paired t-tests

	n	Mean pre-test score (SD)		Mean post-test score (SD)*		Difference
Overall	1226	68.8	(18.2)	83.8	(14.7)	15.0
Sex						
Male	242	69.0	(18.9)	82.0	(15.2)	12.9
Female	984	68.8	(18.0)	84.3	(14.5)	15.5
Age						
35 or younger	299	69.7	(18.8)	85.2	(14.0)	15.5
36 to 50	592	70.2	(18.1)	84.7	(14.4)	14.5
Older than 50	334	65.7	(17.2)	80.9	(15.3)	15.2
Years of Experience						
Less than 5 years	472	68.6	(17.5)	84.6	(13.2)	16.1
5 to 10 years	469	69.5	(17.4)	84.3	(14.5)	14.8
More than 10 years	190	73.1	(18.3)	84.2	(14.8)	11.0
Education						
Less than high school	20	38.3	(14.7)	63.0	(17.8)	24.7
High school	714	65.6	(17.5)	81.8	(14.7)	16.2
College or university	375	75.9	(16.2)	88.8	(12.4)	12.9
City						
Ndola	468	70.1	(17.4)	83.3	(14.5)	13.3
Kitwe	369	71.3	(18.0)	86.0	(13.1)	14.8
Chingola	236	65.4	(18.2)	81.7	(16.5)	16.3
Luanshya	114	69.4	(16.0)	86.4	(12.3)	17.1
Medical Knowledge						
Non-medical background	349	61.9	(16.6)	78.2	(15.3)	16.2
Medical professional	821	72.7	(17.1)	86.8	(12.8)	14.2
Training Type						
Counseling	419	58.2	(13.2)	79.6	(14.6)	21.4
Laboratory testing	430	74.6	(15.7)	86.1	(11.6)	11.5
Data management	349	76.6	(18.2)	87.2	(15.8)	10.6
Training Year						
2010 and earlier	138	63.8	(16.9)	79.0	(14.6)	15.1
2011	740	71.9	(17.3)	86.4	(12.8)	14.6
2012 and later	348	64.3	(19.1)	80.2	(17.0)	15.8

*All p-values for the paired t-tests are statistically significant ($p < 0.001$)

TABLE 3. Effect of training on test scores by training type using paired t-tests*

	Counseling				Data Management				Laboratory Testing			
	n	Mean pre-test score (SD)		Mean post-test score (SD)		*n*	Mean pre-test score (SD)		Mean post-test score (SD)		*n*	Mean pre-test score (SD)		Mean post-test score (SD)	
Overall	419	58.2	(13.2)	79.6	(14.6)	349	76.6	(18.2)	87.2	(15.8)	430	74.6	(15.7)	86.1	(11.6)
Sex															
Men	75	55.0	(9.9)	74.6	(13.6)	66	76.2	(22.0)	86.6	(16.7)	97	75.3	(16.1)	84.3	(13.7)
Women	344	59.0	(13.7)	80.7	(14.6)	283	76.7	(17.3)	87.3	(15.6)	333	74.4	(15.6)	86.6	(10.9)
Age															
Younger than 36	92	57.1	(13.0)	81.8	(12.7)	80	78.2	(18.0)	91.3	(12.2)	114	77.5	(13.4)	86.2	(12.1)
36 to 50	196	60.0	(14.0)	81.8	(14.7)	172	77.1	(19.1)	86.3	(17.1)	217	74.7	(16.2)	86.3	(11.2)
Older than 50	130	56.4	(11.7)	74.8	(14.8)	97	74.4	(16.9)	85.2	(15.7)	99	71.0	(16.5)	85.4	(12.1)
Years of Experience															
Less than 5 years	197	57.4	(13.8)	80.1	(13.5)	115	76.5	(16.5)	89.4	(12.7)	160	76.6	(14.5)	86.8	(11.3)
5 to 10 years	156	57.4	(11.7)	78.2	(16.4)	134	78.5	(17.7)	87.9	(13.3)	179	73.2	(15.5)	86.9	(11.6)
More than 10 years	48	64.2	(13.3)	83.1	(12.6)	61	77.2	(20.1)	85.0	(19.5)	81	75.4	(17.9)	84.1	(11.8)
Education															
Less than high school	5	52.0	(5.4)	61.4	(14.5)[1]	4	35.5	(10.5)	55.5	(20.3)[2]	0	0.0	(0.0)	0.0	(0.0)
High school	275	54.5	(10.9)	76.4	(14.6)	173	75.1	(17.2)	86.7	(14.9)	249	72.5	(16.3)	85.0	(12.0)
College or university	107	67.0	(14.7)	88.7	(10.3)	131	80.5	(16.4)	89.4	(15.4)	137	78.5	(14.4)	88.2	(10.7)
City															
Ndola	137	56.6	(11.5)	75.8	(14.5)	165	78.4	(17.5)	86.4	(15.3)	166	72.9	(14.7)	86.5	(11.2)
Kitwe	128	56.3	(10.5)	81.5	(13.9)	82	81.7	(14.6)	93.7	(9.3)	159	78.0	(16.5)	85.8	(12.2)
Chingola	75	52.4	(7.7)	75.3	(15.3)	65	68.8	(22.1)	81.3	(21.3)	96	72.3	(15.5)	86.9	(11.0)
Luanshya	76	70.5	(16.9)	87.7	(11.6)	29	69.3	(14.6)	86.9	(13.0)	9	60.3	(8.6)	74.4	(10.0)
Medical Knowledge															
Non-medical background	181	53.0	(10.0)	73.5	(14.8)	74	68.6	(20.0)	81.7	(16.0)	94	74.0	(13.4)	84.3	(12.8)
Medical professional	229	62.1	(13.6)	84.5	(12.5)	258	79.2	(16.7)	89.2	(14.5)	334	74.8	(16.3)	86.6	(11.3)
Training Year															
2010 and earlier	88	55.9	(10.9)	75.3	(14.9)	25	88.0	(10.8)	91.2	(10.1)	25	67.8	(14.8)	79.7	(10.3)[3]
2011	214	55.9	(10.3)	80.0	(14.2)	174	83.7	(12.5)	93.2	(9.2)	352	75.7	(15.8)	87.0	(11.5)
2012 and later	117	64.3	(17.1)	82.2	(14.5)	150	66.5	(19.8)	79.5	(19.1)	53	70.4	(14.4)	83.2	(12.2)

*p-values < 0.001 unless otherwise specified
[1] $p = 0.309$ [2] $p = 0.079$ [3] $p = 0.058$

TABLE 4. ANCOVA analysis of pre and post-test scores

	Pre-test			Post-test		
	β	*t*	*p*	β	*t*	*p*
Pre-test Score				0.48	11.45	< 0.001
Age	-0.01	-0.12	0.906	0.19	0.35	0.728
Years of experience	-0.10	-1.31	0.190	-0.15	-1.46	0.145
Education						
Less than high school	*Ref*			*Ref*		
High school	10.06	2.06	0.040	33.13	1.28	0.202
College or university	16.70	3.38	0.001	19.01	0.73	0.468
Sex						
Female	-0.30	-0.28	0.779	-4.46	-1.34	0.180
Male	*Ref*			*Ref*		
Training Type						
Counseling	-16.00	-8.03	<.0001	-12.04	-2.89	0.004
Data management	14.60	7.69	<.0001	-14.47	-3.28	0.001
Lab testing	*Ref*			*Ref*		
Training Year						
2010 and earlier	21.90	7.55	<.0001	-8.14	-0.41	0.680
2011	23.20	9.58	<.0001	-22.27	-2.39	0.017
2012 and later	*Ref*			*Ref*		
Medical Knowledge						
Non-medical background	4.94	4.67	<.0001	14.79	4.75	< 0.001
Medical professional	*Ref*			*Ref*		
City						
Ndola	*Ref*			*Ref*		
Kitwe	10.43	1.25	0.211	-8.55	-1.38	0.200
Chingola	21.88	6.35	<.0001	-14.61	-3.35	0.001
Luanshya	16.05	1.17	0.242	-26.11	-2.28	0.023

APPENDIX A: Formation of the pre-test ANCOVA model

Outliers: No implausible values

Assumptions:	**Assessed via:**	**Interpretation:**
Linearity	Partial plots	No gross violation of linearity
Normality	Normal probability plot	No gross violation of normality
Homoscedasticity	Residual plot	No fanning
Independence	Residual plot	Appears to be random scatter

Multicollinearity: All VIFs < 10

Significant Interaction Terms:	*p*-Value
Training type * city	0.0001
Training year * city	0.0141

Coefficient of Determination	R^2
Without any interaction	0.377
With all interactions	0.480
With only significant interactions	0.435

Final Model:	DF	F-value	*p*-Value
Age	1	0.01	0.906
Years of experience	1	1.72	0.190
Education	2	25.5	<.0001
Sex	1	0.08	0.779
Training type	2	92.72	<.0001
Training year	2	20.36	<.0001
Job	1	21.83	<.0001
City	3	5.11	0.0016
Training type * city	6	12.62	<.0001
Training year * city	2	23.2	<.0001

APPENDIX B: Formation of the post-test ANCOVA model

Outliers: No implausible values

Assumptions:	**Assessed via:**	**Interpretation:**
Linearity	Partial plots	No gross violation of linearity
Normality	Normal probability plot	No gross violation of normality
Homoscedasticity	Residual plot	No fanning
Independence	Residual plot	Appears to be random scatter

Multicollinearity: All VIFs < 10

Confounding (within 10% of pre-test β = 0.362)	β
Age	0.340
Years of experience	0.337
Education	0.350
Sex	0.334
City	0.336
Training Type	0.347
Training Year	0.351
Psychosocial Training	0.359
HIV Algorithm	0.340
Medical Knowledge	0.337

*No confounding - all values are within 10% of the pre-test β (0.036, 0.379)

Significant Interaction Terms:	*p*-Value
Pre-test * medical knowledge	0.021
Age * education	0.018
Age * sex	0.029
Years of experience * training year	0.031
Education * training year	0.003
Training type * training year	0.025
Training type * city	0.001

Coefficient of Determination	R^2
Without any interaction	0.402
With all interactions	0.502
With only significant interactions	0.457

Final Model:	DF	F-value	*p*-Value
Pre-test	1	218.59	< 0.001
Age	1	0.01	0.920
Years of experience	1	7.57	0.006
Education	2	3.07	0.047
Sex	1	1.80	0.180
Training type	2	1.81	0.165
Training	2	0.19	0.826
Job	1	22.54	< 0.001
City	3	1.48	0.219
Pre-test * medical knowledge	1	10.58	0.001

Age * education	2	4.06	0.018
Age * sex	1	3.77	0.053
Years of experience * training year	2	1.93	0.146
Education * training year	4	3.66	0.006
Training type * training year	4	3.58	0.007
Training type * city	6	5.09	<.0001
Training year * city	2	6.84	0.001

APPENDIX C: IRB letter of approval

EMORY UNIVERSITY | Institutional Review Board

TO: Susan Allen
Principal Investigator
Pathology - Main

DATE: March 22, 2013

RE: **Continuing Review Expedited Approval**
CR1_IRB00056257

IRB00056257
Impact of CVCT on HIV transmission in discordant couples that are identified in Lusaka,Copperbelt, and Southern Provinces.

Thank you for submitting a new application for this protocol. This research is eligible for expedited review under 45 CFR.46.110 and/or 21 CFR 56.110 because it poses minimal risk and fits the regulatory category F(2a)(2b)(5)(7) as set forth in the Federal Register. The Emory IRB reviewed it by expedited process on March 21, 2013 and granted approval effective from **4/16/2013 through 4/15/2014**. Thereafter, continuation of human subjects research activities requires the submission of a renewal application, which must be reviewed and approved by the IRB prior to the expiration date noted above. Please note carefully the following items with respect to this approval:

Any reportable events (e.g., unanticipated problems involving risk to subjects or others, noncompliance, breaches of confidentiality, HIPAA violations, protocol deviations) must be reported to the IRB according to our Policies & Procedures at www.irb.emory.edu, immediately, promptly, or periodically. Be sure to check the reporting guidance and contact us if you have questions. Terms and conditions of sponsors, if any, also apply to reporting.

Before implementing any change to this protocol (including but not limited to sample size, informed consent, study design, you must submit an amendment request and secure IRB approval.

In future correspondence about this matter, please refer to the IRB file ID, name of the Principal Investigator, and study title. Thank you.

Approved documents
Protocol version 2.0 dated 1.10.2013
Bemba consent version 2.0 dated 1.10.2013
English consent version 2.0 dated 1.10.2013
Nyanja consent version 2.0 dated 1.10.2013

Sincerely,

Brandy Covington, BBA, CIP
Senior Research Protocol Analyst

This letter has been digitally signed

CC:			
	Getachew	Betelihem	Pathology - Main
	Keeling	Michelle	ALLEN-RZHRG