
IMPACT OF TELEHEALTH TRAINING ON HEALTH CARE PROVIDERS' KNOWLEDGE IN HIV/AIDS CARE: A MIXED METHODS EVALUATION

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Abstract

Healthcare providers (HCPs) serving HIV-infected patients in rural and underserved areas have limited access to continuing education. A telehealth training programme, Project Extension for Community Healthcare Outcomes (ECHO), was implemented to enhance knowledge and skills of these HCPs in HIV care. A mixed methods approach including quantitative (multilevel modelling and meta-analyses) and qualitative (thematic analysis) components was used to evaluate the impact of ECHO on HCPs' knowledge. Over three years, 98 training sessions were conducted and 654 HCPs attended. ECHO was associated with an increase in knowledge. Change in HCP knowledge differed within ECHO sessions, not across sessions. Four HCP-level factors (achievement of self-stated objective for attending the session, amount of time for the session, intention to make practice changes, and number of sessions attended) and one session-level factor (language used in the session) were associated with the change in knowledge. While increasing knowledge, skills and learning were frequently and intensely cited as objectives for attending ECHO, provider-patient communication emerged as the key to converting the acquired knowledge into practice. Besides communication, most HCPs expressed intention to improve patient clinical management including linking, engaging, and retaining patients in care. Lack of time to focus on HIV/AIDS care, inadequate skills to convey medical information to patients, and patients' lack of insurance to pay for recommended care emerged as barriers to implementing content learned. Implications for research and practice are discussed.

Keywords: Continuing education; eHealth; HIV/AIDS; telehealth; Technology Enabled Learning mixed methods; USA.

Introduction

Human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) continues to be a major public health burden in the United States (US).¹ Currently, about 1.2 million people are living with HIV in the US.² Florida, with 2.6% of its population infected with HIV, is among the States with the highest estimated number of HIV infections.¹ While Florida, like most states, uses federally qualified community health centres as a strategy to reduce HIV incidence in rural and underserved areas,³ providing high-quality primary and specialty HIV/AIDS care in these resource-constrained settings poses challenges to healthcare providers (HCPs).^{3,4} Most HCPs (e.g., physicians, dentists, nurses, nurse practitioners, physician assistants, and pharmacists) in these areas receive patients who often have to travel long distance or wait for extended periods of time before receiving specialty appointments. Some of these patients forgo treatment while others do experience severe complications by the time they seek help.^{4,5} Most HCPs in these settings often are not optimally equipped to manage complex cases such as treatment-related adverse events, hepatitis co-infection, depression, and other comorbidities partly due to lack of opportunity to interact with specialists or lack of advanced specialty training.^{6,7} That is, most HCPs in these settings have limited access to continuing education and encounter professional or geographic isolation from tertiary care or teaching hospitals where much of the useful information is likely to be

obtained.^{8,9}

Currently, HIV-related training opportunities in Florida, Puerto Rico, and the U. S. Virgin Island (USVI) include education provided by pharmaceutical companies, HIV education at regional conferences, HIV/AIDS symposium, education from co-workers, and preceptorship and clinical training programmes. Most HCPs in rural communities, however, rarely attend off-site trainings due to restrictions on travel, inadequate funding, inability to be away from clinical practice due to lack of coverage,⁹ and restrictive employer policies related to education and training during clinical practice operating hours. Some HCPs opt for online continuing education, however, some online training modalities offer limited trainer-learner interactions.

To address concerns about access to specialty HIV/AIDS care in rural and underserved areas of Florida, Puerto Rico, and the USVI, the Florida/Caribbean AIDS Education and Training Centre (F/C AETC), one of the federally-funded regional AETCs, implemented a telehealth training programme, Project Extension for Community Healthcare Outcomes (F/C AETC-Project ECHO[®]), hereafter referred to as ECHO. The model F/C AETC used is an adaptation of the telehealth education and delivery model which was originally developed by the University of New Mexico Health Sciences Centre to manage hepatitis C virus (HCV).^{6,10-12}

The F/C AETC - Project ECHO[®] model uses a live audio-video-based internet-conferencing technology called Adobe Connect Pro[®], to link community HCPs with a multidisciplinary team of university-based specialists (e.g. hepatologists, infectious disease specialists, internists, primary care ARNP and RNs, clinical pharmacists, medical case managers, psychiatrists, and substance abuse specialists) who specialise in the management of HIV and co-morbid conditions. Participants connect via phone and/or online. Each session begins by 5-minute welcome and introduction of participants by a faculty facilitator. This is followed by a 5-minute overview of important points for the session and a brief didactic presentation on a current HIV treatment issue. Next is an interactive discussion of individual case(s) submitted in advance by HCPs. Case presentations address questions related to treatment, adherence, social issues, challenges encountered, best practices, and concerns that would benefit from consultation with experts in the field of HIV treatment. This segment, which lasts

30 - 40 minutes, also includes a question-and-answer period. The whole session lasts about one hour. Participating HCPs can receive continuing medical education (CME) credits. We expected that participating in ECHO equips HCPs with knowledge/skills to deliver specialty HIV/AIDS care in areas where such best-practice care would be unavailable due to aforementioned barriers. Thus, ECHO can be expected to enhance HCPs' capacity to safely and effectively manage people living with HIV/AIDS (PLWHA).

While ECHO has been successfully piloted for treatment of HCV, we are not aware of any systematic investigation of its impact on HCPs' knowledge in providing HIV/AIDS care. In the present study, a mixed methods approach was employed to evaluate the impact of ECHO on HCPs' knowledge regarding management strategies employed for treating and caring for patients infected with HIV or suffering from AIDS. We expect that ECHO, a technology enabled learning (TEL) programme employing adult learning principles, will improve knowledge, skills, and behaviours of HCPs, thus ultimately positively impacting patient outcomes.¹³

Theoretical Framework

ECHO is based on three theories of learning and behaviour change. First, according to Bandura's social cognitive theory,¹⁴⁻¹⁵ learners must believe benefits accrued from performing new behaviours outweigh the costs, have self-efficacy they can perform the new behaviour, and experience positive reinforcement from colleagues viewed as important. Similarly, HCPs can contrast prior practices with acquired knowledge and skills as they observe improvement in patient outcomes following ECHO training sessions. Their self-efficacy is expected to grow as they assume an increased role in managing the patients. Second, according to Vygotsky's situated learning theory,¹⁶ learners construct knowledge and assimilate it if they can model the idealised version of the new task, the task is simplified, the task is engaging, and they are motivated to pursue the task. Similarly, ECHO allows for social interaction and collaboration consistent with situated learning theory. Finally, consistent with community of practice theory,^{16,17} ECHO's one-to-many knowledge networks is an example of a community of learners engaged in knowledge and skill development in providing HIV/AIDS care.

Research Questions

In the quantitative component of this study, we sought to determine the change in self-perceived knowledge after ECHO training, and association of any change with HCP-level factors and (e.g., degree of satisfaction with the training, number of training sessions attended, etc.) session-related level factors (e.g., number of HCPs in the session, language used in the session, etc.).

In the qualitative component of the study, an understanding was sought of HCPs' objectives for attending ECHO training, anticipated change in practice, and perceived barriers to such practice change.

Methods

We employed a partially mixed concurrent dominant status design.¹⁸ "Partially mixed" implies that integration of findings from quantitative and qualitative phases occur after completion of data analyses; "concurrent" implies that both phases are conducted concurrently; and "dominant" implies that the quantitative phase is given more weight with respect addressing the overarching research question, "What is the impact of ECHO training on HCPs' knowledge?"

Data for this study were collected as part of a larger evaluation project. After each training session, participants completed an online evaluation survey within one week. The survey was based on the first two levels of Kirkpatrick's four levels of programme evaluation.¹⁹ That is, reaction (how participants react to the training session) and learning (HCPs' self-perception of the extent to which their knowledge changed as a result of participating in the training).

Quantitative Component

The primary outcome, change in knowledge following the training, was assessed by having HCPs rate their level of knowledge about content covered before and after the training using a 5-point rating scale (1= Novice to 5 = Expert). HCP-level data including reaction to training (i.e., HCPs' self-perceptions of the extent to which information discussed was useful, discussants provided evidence-based suggestions, information was effectively conveyed, interest was maintained, technology did not interfere with the learning process, sessions were organised, and there was opportunity for interaction) and perception of

training's relevance to HCPs' work were rated on a 5-point scale (1=Disagree strongly to 5=Agree strongly). Perceived amount of time for the session (rated on a 3-point scale: 1= Not enough to 3=Just right) and pace of the session (rated on a 3-point scale: 1= Too slow to 3=Just right) were assessed. Finally, HCPs were asked whether their self-stated objective(s) for attending the session were achieved (rated: Yes/No) and whether they would recommend the training to their peers (scored: Yes/No).

Three session-level variables were examined. Session size, a measure of the number of HCPs who attended a particular session, was categorised into three levels: small ($2 \leq n \leq 5$), medium ($6 \leq n \leq 8$), and large (>9). ECHO type, a descriptor of the nature of training session, included four categories: Adolescent/Paediatrics, General HIV Care-En Español, General HIV Care, and HIV/HCV. Language, that is, whether the session was conducted in English or Spanish.

Qualitative Component

The survey included open-ended items requiring participants to state their objective for attending the session, changes they intended to make in their practice following the training or perceived barriers to making practice changes. Responses to these questions constituted the qualitative data.

Data Analysis: Quantitative Component

Multilevel Modelling of Change in Self-Perceived Knowledge

Whenever longitudinal telehealth training such as ECHO is conducted, if a change in knowledge (outcome) occurs, it may be associated with certain HCP-specific factors (e.g., the number of sessions attended, the degree of interaction during the session, etc.) and/or session-specific factors (e.g., type of ECHO session, size of the session, etc.). In modelling this outcome, it is important to consider the clustering of the HCPs (level-1 unit of analysis) within training sessions (level-2 unit of analysis). Failing to consider this nested nature of data is tantamount to assuming that the change in knowledge is independent of the session attended. Such assumption may lead to incorrect conclusions being drawn from the inferential statistics obtained.²⁰ While several studies have examined the impact of multi-session training on HCPs' knowledge or skills²¹⁻²⁵ we are not aware of a

study that has accounted for clustering of HCPs within the telehealth training session in their analysis.

The SAS routine, PROC MIXED, was used to fit multilevel models.²⁶ We began by fitting the unconditional means model (akin to a one-way random effects ANOVA model) to assess the variation of mean change in knowledge across sessions. The outcome, Y_{ij} , was expressed as linear combination of the grand mean γ_{00} , the session effect (μ_{0j}), and a random error associated with the i^{th} HCP in the j^{th} session (r_{ij}): $Y_{ij} = \gamma_{00} + \mu_{0j} + r_{ij}$, where $\mu_{0j} \sim iid N(0, \tau_{00})$ and $r_{ij} \sim iid N(0, \sigma^2)$. Fitting this model to our data allowed us to estimate the fixed effect γ_{00} (the average change in knowledge score in the population) and two random effects, τ_{00} (the variability in means across sessions) and σ^2 (the variability in change in knowledge score within sessions). Next, we added HCP-level factors followed by session-level factors. In building the models, we took note of significant factors and assessed the fit of each model to the data set using $-2 \log$ likelihood ($-2LL$), Bayesian Information criterion (BIC), and the Akaike Information Criterion (AIC).²⁷

Meta-Analysis of Session Data

Analysis of combined data for multiple sessions may be problematic due to differences in training session (e.g., diversity of didactic topic presented, language used in the session, and differences in complexity of cases presented) and size (e.g., fewer than 5 HCPs). The statistical technique, meta-analysis, was employed to combine outcome data from multiple but similar ECHO sessions over a period of time. For each session, we calculated the mean difference in change in knowledge for each HCP and then aggregated the mean difference in knowledge for all HCPs in the session. For the purpose of meta-analysis, we then used these aggregate mean differences from each session and compared across sessions. The participants, intervention comparison, and outcome (PICO) characteristics for our meta-analysis of sessions is as follows:

- **Participants:** Each ECHO session included at least 1 HCP managing PLWHA
- **Intervention:** Participation in at least one ECHO training session
- **Comparison:** Pre-training knowledge level was compared with post-training level
- **Outcome:** Change in knowledge (“post training level” – “pre-training level”)

Because of the potential variation in participant’s characteristics and training session, we selected a *random effects model* and weighed sessions using inverse variance in computing overall programme effect. Examples of variations at the training level include diversity of trainees (clinical and non-clinical trainees), session size, and didactic topic (mental health vs. medication adherence vs. perinatal, etc.). In this study, effect *size* refers to the strength of the relationship between training and change in knowledge as measured by items in the evaluation survey. We used the following standardised mean differences (SMD) as guidelines: 0.2 is a small effect; 0.5 is medium effect; and 0.8 is a large effect.²⁸

Data Analysis: Qualitative Component

Thematic Analysis

Participant’s significant statements in response to open-ended questions were coded, *in vivo*, into themes by two independent coders. Significant statement refer to words or phrases construed to have meaningful responses to the question. In vivo coding is whereby a section of data (statement) is assigned a label using a word or short phrase taken from that section.²⁸ In vivo coding ensured that concepts stay as close as possible to HCPs’ own words and key elements of the construct being described are captured. Each code was constantly compared with the preceding ones to avoid redundancy.

Quantitizing of Qualitative Data

Each emergent theme was assigned a score of “1” if a participant made a significant statement coded under it and “0” otherwise.²⁹ From these scores, we computed theme frequency (the number of participants who cited statement classified under the theme, expressed as a percentage of all participants in all sessions) and theme intensity (the number of statements referring to a particular theme, expressed as percentage of all statements for all themes).²⁹ Quantitizing qualitative data using these two effect size measures enabled us to compare mean change in knowledge score between two extreme subgroups: “highest-gains” sessions (with mean change of knowledge between 0.8 and 2.0) and “lowest-gain/no gains” sessions (mean change of knowledge between 0 and 0.21).

Legitimation of Findings

To enhance legitimating of the findings we performed extreme case analysis whereby theme frequency and

intensity of the ‘highest-gains’ and ‘lowest-gains’ sessions were compared. Two members of our research team coded all data with at least 0.80 inter-coder agreement. In addition multiple-analyst triangulation was ensured by having different members of our research team perform data analysis.²⁹

Results

Quantitative Component

Data for this study were obtained from HCPs who attended training sessions between November 2011 and October 2014. A total of 98 ECHO training sessions were conducted in which 654 HCPs attended (293 unique, unduplicated HCPs). The number of sessions attended by a HCP ranged from 1 to 21 (mean= 5.51, median=4) whereas the number of HCPs in each session (session size) ranged from 2 to 21 (mean= 7.04, median=6). Six of the 98 sessions in which only one HCP attended are not included in the multilevel analysis.

Sessions do not differ in average change in self-perceived knowledge

The results of the unconditional means model showed that while sessions do not differ in their average change in HCPs’ self-perceived knowledge ($\tau_{00} = 0.004325$, $p = 0.1737$), there was indeed significant variation among HCPs within sessions ($\sigma^2 = 0.3207$, $p < 0.0001$). Estimates of the intra-class correlation ($\rho=0.013$), the portion of the total variance occurring between sessions, suggest existence of some clustering of knowledge change within sessions. Overall, multilevel modelling results showed an average 0.4957 points increase in knowledge across sessions.

Change in self-perceived knowledge is associated with certain HCP-level factors

When HCP-level factors were added to the unconditional model (Table 1, Model 1), change in HCP’s knowledge was associated with: “Extent to which technology hindered learning”, “Amount of time for the session”, “Whether HCPs intended to make practice changes,” and “Number of sessions attended.” Factors such as “Whether HCP’s objectives were achieved”, “Extent to which discussants provided evidence-based suggestions,” “Pace of the session,” or “Relevance to work of what was learned” were not associated with change in HCP’s knowledge.

Change in self-perceived knowledge is associated with certain HCP- and session-level factors

By adding session-level factors to the model containing HCP-level factors and running different models, each time comparing model fit, the model that best fitted our data indicated that one new HCP-level factor, “Whether HCP self-stated objective for attending the session was achieved,” was significant (Table 1, Model 2). However, in this model, “Extent to which technology hindered learning” was no longer significant. In addition, none of the four session-level factors, which were added, was significant. Next, we fitted a model in which non-significant HCP-level factors were excluded (Table 1, Model 3), however, none of the session-level factors were significant. Our final model (Table 1, Model 4) shows that four HCP-level factors (“Whether HCP self-stated objective for attending the session was achieved”, “HCPs’ perception about amount of time for the session”, “Whether HCPs intended to make practice changes”, and “Number of sessions attended”) and one session-level factor (“Language used in the session”) were associated with change in HCP knowledge. With respect to language, there was a significant increase in knowledge in Spanish sessions compared to English sessions.

With the exception of results related to language used in the session, results of meta-analysis of change in knowledge across sessions were comparable to the multilevel modelling results. Overall, we found a statistically significant medium effect in favour of ECHO training (standardised mean difference [SMD] = 0.485, 95% CI: 0.444, 0.525). We were unable to present forest plots for the full data set as Comprehensive Meta-Analysis (CMA) software could only show forest plots of the first 72 of 92 sessions. (Figure 1) While multilevel analysis showed that language used in the session was a significant factor, subgroup analysis of meta-analysis showed that average increase in knowledge score in English sessions were not statistically different from scores in Spanish sessions, SMD=0.48 (95% CI: 0.443, 0.526) and SMD=0.491 (95% CI: 0.340, 0.642), respectively (test of interaction: $p=0.934$).

Qualitative Component

HCPs have diverse objectives for attending ECHO

A total of 289 HCPs (99%) made 662 significant statements describing their objective for attending the

the training, 2.3 statements per HCP. In vivo coding of these self-stated objectives, 10 themes (objective types) emerged (Table 2).

The three most frequently and intensely cited objectives for attending the training were “Knowledge/skill,” “Learn” and “Education/ CEU” in that order (Table 3). Detailed description of all themes on objectives for attending the training are provided in Appendix A.

HCPs intend to make diverse changes following ECHO training

Besides 79 participants and 38 participants who responded “not applicable” and “no change” respectively, 176 HCPs (60%) made 368 significant statements describing changes in practice they intended to make following a training session, 2.1 statements per HCP. These statements were coded into 14 emergent themes (Table4).

Table 1. Parameter estimates, standard errors, and goodness of fit indices for modelling change in HCP’s knowledge following ECHO training (648 HCPs, 92 sessions).

Variable	Model 1	Model 2	Model 3	Model 4
Intercept [‡]	0.143(0.28)	0.095(0.30)	0.377(0.23)	0.253(0.20)
Achievement of objective(s)	0.308(0.16)	0.318(0.15)*	0.399(0.15)*	0.385(0.15)*
Information discussed is useful	0.129(0.07)	0.109(0.06)	0.064(0.05)	0.064(0.05)
Evidence-based suggestions	-0.114(0.07)	-0.094(0.07)	-0.094(0.07)	-0.094(0.07)
Knowledge about case presented	0.013(0.06)			
Satisfaction with session	-0.026(0.09)			
Information conveyed effectively	0.033(0.07)			
Interest was maintained	0.110(0.07)	0.086(0.06)		
Technology did not hinder learning	-0.081(0.03)*	-0.062(0.03)		
Session was organised	0.057(0.08)	0.073(0.07)		
Opportunity for interaction	-0.048(0.06)	-0.059(0.05)		
Relevance to work	-0.020(0.06)			
Perceived amount of session time	0.099(0.05)*	0.116(0.05)*	0.102(0.05)*	0.099(0.05)*
Pace of the session	-0.008(0.06)	0.005(0.06)		
Intention to make practice changes	-0.200(0.05)*	-0.203(0.04)*	-0.235(0.04)*	-0.235(0.04)*
Number of sessions attended	-0.015(0.00)*	-0.011(0.00)*	-0.010(0.00)*	-0.010(0.00)*
Session size: <i>Small</i> ($2 \leq n \leq 5$)		0.005(0.09)		
: <i>Medium</i> ($6 \leq n \leq 9$)		-0.027(0.05)		
: <i>Large</i> ($10 \leq n \leq 18$)		0.000 (.)		
ECHO Type: <i>Adolescent/Paediatric</i>		-0.158(0.09)	-0.150(0.09)	
: <i>En Español</i>		-0.113(0.15)	-0.165(0.15)	
: <i>General HIV care</i>		-0.166(0.09)	-0.170(0.09)	
: <i>HIV/HCV</i>		-0.163(0.09)	-0.166(0.09)	
<i>Language: English</i>		-0.223(0.14)	-0.291(0.14)	-0.291(0.07)*
-2 log likelihood (-2LL)	1097.9	1091.2	1079.5	1071
Akaike Information Criterion (AIC)	1101.9	1095.2	1083.5	1075
Bayesian Information criterion (BIC)	1102.3	1095.6	1083.8	1075.4

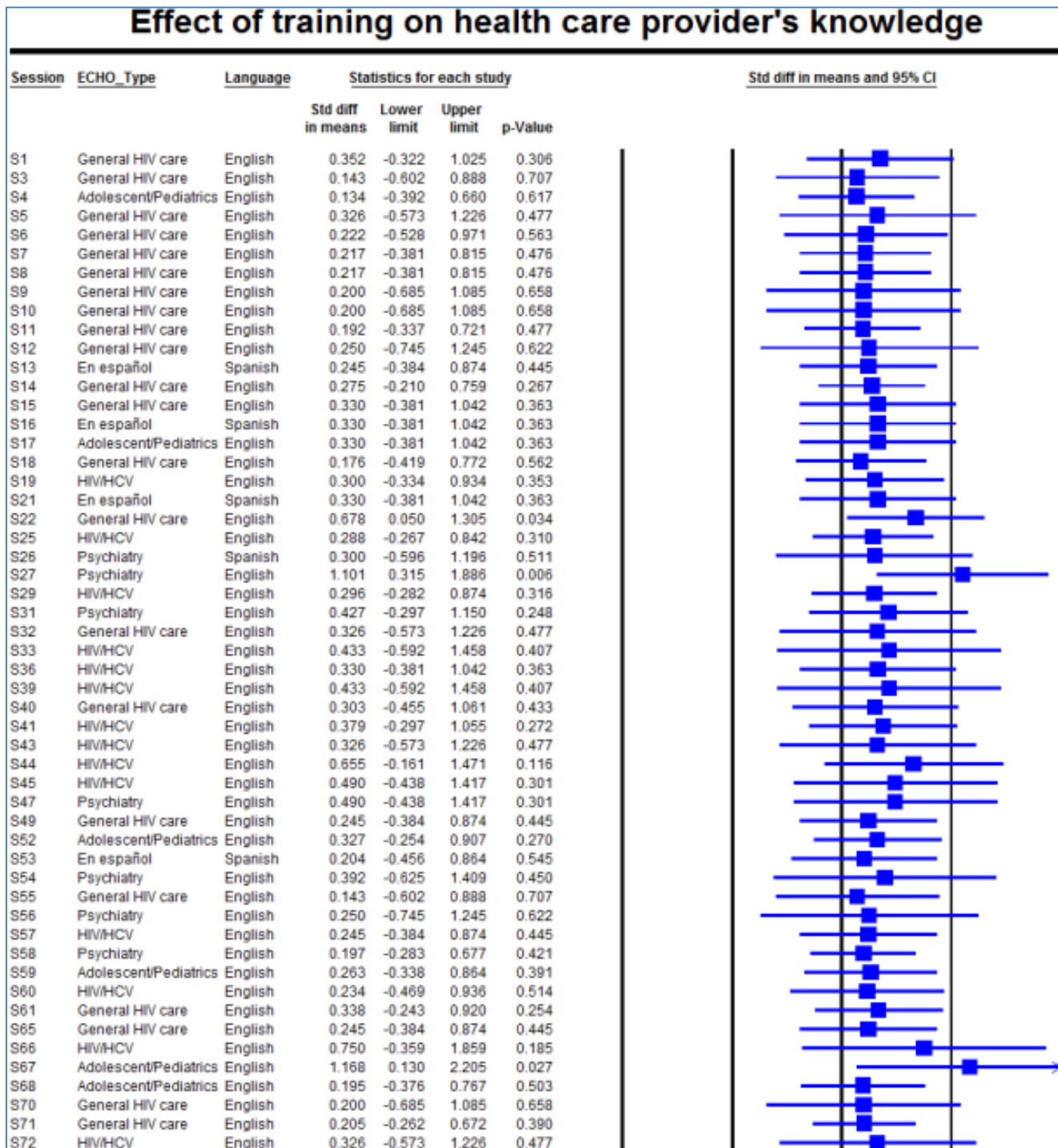


Figure 1. Effect of ECHO training on HCPs’ knowledge (N = 648 HCPs).

Note: Only data set for 72 of 92 sessions can be shown by CMA software. Pooled estimate (SMD = 0.485, 95% CI: 0.444, 0.525) is not shown.

Table 2. Objectives for Attending ECHO Training: Themes, Descriptions/Definitions, and Sample Significant Statements.

Theme	Description/definition (italicised) and sample significant statement (in quotes)
1. Knowledge/Skill	<i>To increase, gain, or update knowledge:</i> “Increase knowledge,” “Expand my knowledge,” “Enhance understanding of disclosure” and “Keep current”
2. Learn	<i>To learn more:</i> “Learn about HCV,” “Learn any new updates,” “Learn from every case I hear about,” “Learn how to manage HIV/HCV patient,” and “Learn more”
3. Education/CEU	<i>Continuing education and/or obtain CEU:</i> “Acquire CEU for RN license,” “CE credit,” “continuing education in HIV/AIDS,” “Education,” and “Educational”
4. Case	<i>To present a case or obtain expert opinion:</i> “I had a case to present,” “Case based learning,” “Obtaining advice from experts,” and “Hear other opinions about case”
5. Application	<i>To apply knowledge gained to practice:</i> “Apply acquired knowledge to my own patients,” “To better serve my clients,” and “To improve care of clients”
6. Teach	<i>To teach or provide expert opinion:</i> “Consultant,” “Faculty” “Lecturer,” “Teach,” “Review PEP information,” “Teaching/provide consultation”
7. Facilitate	<i>To facilitate:</i> “Facilitator,” “moderate session” and “Session facilitator”
8. Discuss	<i>To participate in discussion:</i> “Discuss cases with peers,” and “Discuss perinatal care,” “Discussion of clinic cases with experts in the field”
9. Network	<i>To network or collaborate with others:</i> “Collaboration,” “Network with other HIV providers,” “Networking,” and “Participate and network”
10. Observe	<i>To observe the session:</i> “To observe Perinatal Project ECHO,” “Observe the new ECHO session offered by F/C AETC,” and “Observe TeleECHO clinic.”

Table 3. Objectives for attending ECHO trainings: theme “frequency” and “intensity” (expressed as percent).

Theme	Combined		High (0.8 ≤ Δ ≤ 2.0)		Low (0.0 ≤ Δ ≤ 0.21)	
	Frequency (N = 654) ^a	Intensity (N = 662) ^b	Frequency (n = 85) ^a	Intensity (n = 87) ^b	Frequency (n = 92) ^a	Intensity (n = 98) ^b
1. Knowledge/Skill	41.3	40.8	50.6	49.4	30.4	30.4
2. Learn	28.4	28.1	24.7	24.1	35.9	35.9
3. Education/CEU	13.3	13.1	11.8	11.5	13	13
4. Case	4.7	4.7	6.1	5.9	6.7	6.7
5. Application	3.7	3.6	3.5	3.4	2.2	2.2
6. Teach	2.4	2.4	-	-	7.3	7.3
7. Facilitate	2.4	2.4	5.9	5.7	3.3	3.3
8. Discuss	1.5	1.5	1.2	1.1	3.3	3.3
9. Network	1.2	1.2	-	-	2.2	2.2
10. Observe	0.7	0.7	2.4	2.3	2.2	2.2

Combined = all HCPs who provided at least one significant statement about their objective for attending the training; Δ = mean change in knowledge; **High** = subgroup of HCPs in sessions in which mean change in knowledge score was between 0.8 and 2.0; **Low** = subgroup of HCPs in sessions in which mean change in knowledge score was between 0 and 0.21; **a** = total number of HCPs; **b** = total number of significant statements made; Frequency or Intensity ≥10 is in bold.

Table 4. Intended changes in practice following ECHO Training: Theme “Frequency” and “Intensity” (expressed as percent).

Theme	Frequency (N = 351) ^a	Intensity (N = 378) ^b
1. HCP-patient communication (e.g., education, counselling, etc.)	15.9	15.2
2. Clinical management (e.g., assessment/screening, evaluation, etc.,)	15.0	14.4
3. Knowledge (utilisation, update, increase, or application)	9.6	9.2
4. Continuing current practice (e.g., assessment, evaluation, screening, etc.)	9.6	9.2
5. Screening or review of patient information	8.5	8.2
6. Networking, collaboration, or information sharing	8.2	7.9
7. Linkage, engagement, or retention in care	7.9	7.6
8. Increase in awareness (for patient or self-awareness)	6.8	6.5
9. Closer monitoring (e.g., psychiatric issues, drug interactions etc.)	5.1	4.9
10. Uncertain/unspecified changes	4.0	3.8
11. Case management or case presentation	3.1	3.0
12. Incorporate recommendations from the session	2.3	2.2
13. Learning (e.g., learn about drug interaction, HCV management etc.)	2.3	2.2
14. Patient referral	1.7	1.6

Note: a = total number of HCPs; b = total number of significant statements made; Frequency or Intensity ≥10 is in bold.

Discussion

The purpose of this study was to evaluate the impact of ECHO, a telehealth education and training programme aimed at enhancing knowledge and skills of HCPs in HIV care. To do so, a mixed methods approach was employed. Though limited, research has shown that offering online HIV courses to HCPs in resource-constrained settings is feasible, and valuable, and may address logistic and economic barriers to the provision of high quality education in these settings.³⁰⁻

³² Overall, our findings are consistent with existing literature from these studies and are discussed next.

Change in knowledge differs within sessions, not across sessions

Results of the quantitative component suggest that sessions do not differ in average change in HCPs’ self-perceived knowledge: the average change in knowledge is approximately 0.5 points. However, there are differences among HCPs within sessions: 1) HCPs who perceive the amount of training time is long experience less change in knowledge than those who perceive it is as appropriate; 2) HCPs who intend to make practice changes experience more knowledge

change than those who have no intention to make practice changes; and 3) HCPs who attend more sessions experience more change in knowledge than those who attend fewer sessions.

Looking at perceived barriers to implementation of content learned (qualitative component), few participants (5%) cite barriers. Besides the predominant barrier of time, examples of barriers which emerge include patients’ participation, compliance, or adherence; HCPs’ attitude or participation in the programme; and socioeconomic/financial barriers. While only a few barriers were identified in this evaluation, institutions replicating ECHO should consider addressing these barriers in planning their training sessions in order to increase participation rates.

HCP-patient communication is key to application of acquired knowledge

Achievement of HCP self-stated objective for attending the training is associated with increase in knowledge, both at HCP- and session-level analyses (quantitative). To increase knowledge, to learn, and to apply content in practice are among the most frequently and intensively cited objectives for

attending ECHO (qualitative). Effective provider-patient communication is identified as key to application of acquired knowledge. Consistent with this finding, research shows that effective clinical communication continues to be a problem for many HCPs managing HIV/AIDS.³³⁻³⁶ Comments from HCPs suggest that communication should be a key element of telehealth training. The use of motivational interviewing and general counselling techniques should be emphasised. Important topics to cover may include contraceptive options, adherence issues, dealing with at-risk populations, diet/exercise, drug side effect, and dental evaluation.

Perceived amount of time for the session is associated with change in knowledge

HCPs who perceive the amount of training time to be long experience less change in knowledge than those who perceive it is as appropriate. This finding suggests that programme planners should determine not only how long the session lasts but also when or time of the day (timing) it is to be conducted. Efforts should be made to ensure participant's time is used productively during the session.

Intention to make practice changes is associated with change in knowledge

Expression of intention to make practice changes is associated with increased change in knowledge, a finding consistent with the Theory of Planned Behaviour³⁸ which posits that behaviour performance is preceded by intention. Besides HCP-patient communication, the next most frequently and intensely cited practice change is clinical management. This includes patient assessment/evaluation, patient screening, patient advocacy, and researching on innovative ways of medication cost coverage. It appears that participating in ECHO enhances HCPs' self-efficacy in performing these important clinical management tasks. Another set of practice changes identified included networking, collaboration, or information sharing. This finding is supported by research showing that ECHO builds communities of practice that enhances professional development and satisfaction of HCPs, and expand sustainable capacity for care by building local centres of excellence.^{10,12,38-40}

Telehealth represents a mechanism to recruit and retain HCPs in resource-constrained areas and reduce their isolation via networking opportunities.^{42,43} The finding that HCPs intended to link, engage, and/or

retain patients in care is intriguing given the negative health impact of non-engagement in care such as delayed ART initiation, virologic failure, and mortality.⁴³⁻⁴⁷ The finding that patient referral is the least frequently and least intensely cited factor is interesting. Perhaps participation in ECHO leads to fewer patient referrals because ECHO attendees are able to address most of cases they were not able to address prior to participation in ECHO.

Number of sessions attended is associated with change in knowledge

The quantitative findings suggest that the more one attends the more one learns, suggesting that HCPs should be encouraged to attend more sessions before they start seeing a change in knowledge. If this is the case, providers in employment settings that do not allow attendance at sessions occurring during business hours where they would normally see patients may be missing out on this TEL opportunity. The increase in knowledge associated with the increase in the number of sessions attended might be related to improved comfort level within the new learning environment or an initial low level of knowledge.

Language used in the session is associated with change in self-perceived knowledge

The finding that more gain in knowledge is reported in Spanish sessions than in English sessions is surprising. We suspected that Spanish sessions might have the same HCPs at each session thus facilitating learning. However, English sessions had on average more people attending than Spanish sessions, 6.0 (SD=5.4) and 2.3 (SD=1.7), respectively. Perhaps, because HCPs in Spanish sessions attended relatively more consistently, this may create a learning network and comfortable environment which leads to more knowledge gain. Also, given that Spanish sessions lasted longer than English session (1.5 hours vs. 1.0 hour), the extra time perhaps allowed participants to learn more. Only one HCP in a Spanish session cited time as a barrier, compared to 5 HCPs in English sessions.

Limitations

We asked HCPs to report on process-relevant behaviours (e.g., perceived level of knowledge about content covered in the training), an approach which poses difficulty to participants in terms of question wording, format, and context.⁴⁸ However, we

employed mixed methods strategies to enhance legitimation of our findings. For example, not only do we ask HCPs to state if their objectives were achieved (quantitative phase), we ask them to state their objective for attending the training (qualitative phase). Similarly, by asking participants to state changes in practice they intended to make following ECHO training (qualitative phase), it can be inferred whether or not they intend to make changes without asking in the quantitative phase. Another limitation of this study is that HCPs were asked about their perceived level of knowledge of content covered before and after each session, an approach that may be viewed as being of limited application. However, it serves the process evaluation goal of assessing the extent to which HCPs perceive ECHO as impacting their knowledge in HIV management, so that changes may be effected if needed rather than waiting.

Conclusion

Data from this mixed methods evaluation suggest that change in HCP knowledge differs within ECHO sessions, not across sessions. ECHO is associated with a medium increase in HCPs' knowledge. HCPs who attended more sessions, expressed intention to make practice changes, or perceived the length of training time as being appropriate experienced more knowledge gain than those who attend fewer sessions, had no intentions to make practice changes, or perceived the length of training time as being long. Spanish sessions reported more gain in knowledge than English sessions. Most HCPs attend ECHO training with the objective to increase their knowledge/skills, learn, or obtain CEUs. Following the training, most HCPs intend to enhance communication with their patients and improve clinical management including patient linkage, engagement, and retention in care. Lack of time to focus on HIV/AIDS care, inadequate skills in conveying medical information to patients, and patients' lack of insurance to pay for recommended care were cited barriers to implementing content learned. Future research should focus on addressing these barriers.

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Appendix A.

Detailed Description of Themes on Objectives for Attending ECHO Training

Knowledge/skills: While most participants stated that their objective was to increase knowledge/skills (e.g., “Gain more knowledge and insight,” “Improve my knowledge,” “Update knowledge base” and “Increase knowledge”), a few specified the knowledge area: “Increase knowledge of meds” and “Increase general HIV knowledge.” Frequently cited areas of interest included HIV/HCV co-infection, drug interactions, psychiatric issues, paediatric or adolescent HIV populations, and general HIV management. Other participants connected gaining knowledge to improvement of patient outcomes: “To increase my knowledge to enhance patient outcomes,” “To obtain knowledge to better assist our patients,” and “To acquire information which will better assist with health care services provided to the HIV/AIDS community including improving linkage to care and treatment.”

Learn: Unlike knowledge, most participants not only stated their objective was to learn (“Aprender [learn],” “Learning” and “Learn and teach”), they also specified what they were interested in learning: “Learn about ARV meds interactions with antidepressants,” “Learn about changes to new treatment guidelines,” and “Learn HCV and care.” Again, frequently cited areas of interest included HCV management, psychiatric/depression issues, drug interactions, HIV/HCV co-infection, treatment-related adverse events, paediatric/adolescent HIV populations, patient retention/engagement, HIV resistance, aging population, and HIV management. As with knowledge, some HCP connected learning with patient outcomes: “To learn to better serve my clients,” “To learn about HIV treatment in patients with TB,” and “To learn more about issues that clients with HIV/HCV co-infection have as well as methods and barriers to care.”

Education/CEU: The majority of participants responded their objective was to continue “Education” or receive “CEU” suggesting interest in continuing education, CEU credits, or professional growth. A few HCPs specified the area in which they needed more education: “Education of TB in HIV patients,” “Education on reproductive health,” “Further

education on contraception for persons with HIV” and “To be better educated on HIV/TB co infection.” Some participants linked education with client benefits: “Educate and update on providing holistic care to HIV patients” and “Educate myself to better work with my clients.” Others linked education to meeting requirements of funding agency: “Requisito para los creditos del Programa Ryan White [Requirement for Ryan White Programme credits].”

Case: Some participants, mostly case presenters, stated their objective was to present a case or obtain expert opinion on cases presented: “Share my clinical experience of a case and to discuss with other experts for additional information and insight into practice,” “To present a case for discussion and to gain more understanding of Hep C,” “Get second opinion about difficult cases,” “Manage my patients in the best way through interaction and case studies with other HIV clinicians...,” and “To hear discussion from the experts as well as questions and cases.”

Application: Statements from some participants suggested they attended the session with the objective to apply what they learned: “I work with young adult and this information would be very useful,” “To apply evidence based care for my patients,” “Integrate the novel regimens discussed,” and “Beneficiar a mis pacientes al of recer los servicios de manejo de caso” [“Benefit my patients to offer case management services”].

Teach: A few participants, mostly faculty members, attended the session to share their expertise: “Provide information about improving adherence among HIV patients,” “To review clinical management,” “Review of HAART medication,” “Teaching/provide consultation,” and “Review PrEP information.”

Facilitate: Closely related to attendees whose objective was to share their expertise, other participant’s main role was to facilitate the sessions. Examples of quotes included “Facilitate,” “Facilitator,” “Moderate session,” and “Session facilitator.”

Discuss: Statements from some participants indicated they were interested in the discussion aspect of the training: “Discuss and review HCV treatment in HIV positive patients,” “Discuss cases with attendees,” and “Discuss ideas for increasing medication compliance.”

Observe: Some participants stated that their objective was to observe or support the training session. For example, “Observe the new ECHO session offered by F/C AETC,” “... to observe Perinatal Project ECHO,” and “Observe the TeleECHO clinic.”

Appendix B.

Detailed Description of Themes on Intended Changes in Practice Following ECHO Training

HCP-patient communication: Broadly, participants’ statements suggested that they intended to engage in more effective communication, either in the form of education or counselling. Education-related communication focused on *dental evaluation* (“Emphasise to my patients about the importance of dental visits” and “Concientizar a la poblacion de la importancia de su evaluacion dental” [“Sensitise the population of the importance of dental evaluation”]), *drug interaction* (“Have greater awareness of medication interactions”), *drug side effects* (“Create patient awareness about important and common side effects of ARV therapy”), *eye protection* (“Insist that all of the patients, but particularly the elderly and immunocompromised protect their eyes”), and *general health* (“Will use newest info for educational purposes for clients”). Counselling-related communication included the use of *motivational interviewing* (“Improve motivational interviewing skills,” “More detail questions asked about patient history,” “I intend to listen and understand my clients,” and “More detailed/structured interviewing directed at coping strategies”), *contraceptive options* (“Inquire of all HIV+ clients what contraceptive method, if any, is used and discuss the need for follow-up with their infectious disease physician” and “Discussing current contraception use and options with patients”), *adherence issues* (“Speak more directly with patients about missed doses of meds”), *diet/exercise* (“Diet counseling and supplementation” and “To talk to my clients about exercise and better nutrition”), *disclosure* (“Explore disclosure in greater detail,” “Consider role-play for individuals struggling with disclosure,” “Discuss the issues of disclosure in the household...”),

at-risk populations (“Discuss more openly with patients that are high risk about the possibility of PrEP...” and “Discuss sex and substance use with clients 50+”), adolescents (“Appropriately counsel sexually active teens on BC” and “...renew my efforts to talk with adolescents about STDs and HIV infection and how it is clearly present in "rural" Florida”), and *general counselling* (“Provide informative counselling sessions for the clients I am currently working with” and “dar mas orientacion” = “give more guidance”).

Clinical management: Participants’ statements coded under this theme focused on several practices including *assessment/evaluation* (“Begin assessing patients for dementia,” “Evaluate better neurological problems in HIV population,” and “I can now better evaluate a patient in order to make an accurate diagnosis”), *screening* (“Alter TB screening practices” and “Improved cancer screening”), *patient advocacy* (“Advocate for an adolescent peer navigator” and “Advocate for DOT therapy in special cases”), *starting new treatments* (“Begin HCV treatment with DAA for connected patients,” “I will start treating hepatitis c in my practice...” and “Change patient's HIV ART in preparation for HCV treatment”), *seeing new patients* (“I will start treating my co-infected patients,” “Work up initial patient for HCV treatment,” and “Increase confidence in treating patients with mental illness”), providing treatment options (“Suggest change to vaccine practice” and “Explore implementation of HPV vaccination for our HIV positive client population”), research on *medication cost coverage* (“Research ways to cover cost of vaccine in adults over age 26”), and instituting *general practice changes*

(“Focus on pregnancy issues and ARVs” and “Support the adolescent”).

Knowledge: Participants’ statements indicated how they intended to utilise, update, increase, or apply knowledge either in general practice or in specific areas of their work. The following are examples of significant statements: *utilisation* (“Utilising more screening tools such as the PHQ9,” and “Utilizar los conocimientos adquiridos para dar un mejor servicio al paciente” [“Use the knowledge gained to better serve the patient”]); *update* (“Update knowledge base,” and “Update treatment plan”); *increase* (“Increase my knowledge base” and “Continue to increase my knowledge in HIV management”); and *application* (“Apply what I learned with my HIV+ patients,” “I’m implementing the knowledge from this session into my clinical practice,” “Incorporate the information learned when providing healthcare to my adolescent patients”).

Continuing current practice: Whereas participants were asked to state changes they intended to make, some made statements suggesting knowledge gained from the training reinforced their current practices, which they intended to maintain. These included *providing appropriate treatment* (“Continue to prescribe appropriate contraception to my HIV adolescent population,” and “The presentation reinforced current interventions and ongoing management that is in place”), *assessment* (“Continue assessing potential Hep C positive patients” and “Continue evaluating HCV positive patients”), *screening/evaluation* (“Continue insuring appropriate screening and evaluation for TB is done”), and general practice (“The programme reinforced current practice” and “Consistent with my current practice,”).

Patient screening/review of information: While screening and review of patient information were already regular practices by some participants, to others these were new practices they were yet to begin following ECHO training. With respect to *screening*, the participants commented: “Intend to diagnose dermatologic conditions related to ARV and its S/S,” “Do more cognitive screening of my patients who are HIV positive using recommended tools,” “Do more screening for mental health comorbidities,” and “I will screen my co-infected patients annually for dementia,” “My practice will start screening for cognitive decline and discuss boundary setting for the appropriate

patients”). Sample statements related to *review* included “Review new recommendations for contraception,” “Review HIV meds that can cause psych symptoms,” and “Review VL prior to initiating AZT drip.”

Networking, collaboration, or information sharing: Statements from some participants suggested they intended to *network* (“Network with persons with similar duties”), *collaborate* (“Collaborate with co-workers about follow up care,”), or share information with peers and others (“Inform staff about recognising the need to discuss PrEP,” “Compartir el conocimiento con los compañeros de trabajo” [“Sharing knowledge with colleagues,” “Pass the information to all care providers],” and “Share info with peers”).

Linkage, engagement, or retention in care: Statements from some participants indicated that they intended to link, engage, or retain patients in care. Examples of statements included *linkage* (“Look for more community based services to support pregnant teens in their communities who are HIV-positive,” and “Improve transitions to adult care”), *engagement* (“To engage more with client who are out of care,” “Explore more opportunities to reach out to “less adherent” patients on a regular basis to try to keep them engaged in care,” “To learn more about client behaviours and to assist them with engagement in mental health services,” and *retention* (“I will treat more of my co infected patients” and “Attempt to follow the HIV prenatal cases along with the OB physician”). Some participants specified what resources they would utilise to link, engage, or retain patient in care: “Continue to use FCAETC resources/consults, etc. to maximise HAART regimens” and “Continue to use Stanford database for HIV genotyping.”

Increase in awareness: Some participants made statements suggesting intention to increase their awareness in different areas including *symptoms* (“More aware of KS symptoms,” and “More aware of what KC looks like”), *treatment option* (“Be more aware of patients other medications” and “Check medication list more closely”), *drug interaction* (“Greater attention to ARV drug interactions”), *obesity* (“Increase my awareness about obesity and inform clients”), *co-infection* (“To be more aware of HIV associated illnesses”), *special care needs* (“Be more

aware of the special care that women with HIV have and provide them the best primary care service as we can”), and *diagnosis* (“Be aware of Hep B and diagnostic approach”).

Close monitoring: Statements from some participants suggested that they intended to closely monitor patients especially in the following areas: *psychiatric/psychological issues* (“Continue reviewing psychiatric medications clients are prescribed,” “Monitor patients for depression symptoms,” “Put more emphasis on mental services during intake,” and “Pay more attention to psychological needs of patients”), *over the counter [OTC] medications* (“Remember to look more carefully at all meds, including vitamins and OTC” and “Indagar mas sobre el uso de medicamentos OTC de mis pacientes],” and “Inquire more about using OTC medications for my patients”), *drug interaction* (“Paying attention to drug-drug interactions”), *adverse reactions* (“... be mindful of the indications or contraindications with ARVs”), *symptoms* (“To identify oral manifestation in my patients relative to HIV”), *pediatric issues* (“ Look for CD4/RN/A on pregnant mothers close to delivery time”), and *general HIV management* (“Pay extra more attention to patients”).

Case management/presentation: A few participants made statements suggesting intention to make case management changes (“Case management changes,” “Changes in management of co-infection and depression screening,” “Management of discussed patient will be changed accordingly,” and “Hep C management of connected case”) and/or comfort in *case presentation* in future sessions (“I feel more comfortable with presenting a difficult patient for review if and when I need to” and “I have compiled a list of Hepatitis C patients and will be presenting in the future in order to receive guidance for treatment”).

Incorporate recommendations: A few participants intended to incorporate recommendations from the sessions into their practice: “Use the recommended cognitive screeners in clinic,” “Follow protocols for HIV and TB treatment recommendations,” “Incorporate the recommendations for care to our programme,” and “Recommending delay of therapy for new HCV therapies in upcoming months.”

Learning: A few participants expressed interest in learning in general (“Continue to learn more,” “Keep learning more and used the most information I acquired for me and my patients,” and “I intent to keep up with learning”) or learning about specific areas of HIV care (“Learn more about drug interactions with ART,” “I want to learn more about HCV treatments and how I can help patients access this care and medications,” and “Continue learning about HIV/HCV, assessment, planning and evaluation”).

Patient referral: Few participants made statements indicating intention to continue referring patients for treatment: “Continuar Orientando y referiendo mujeres embarazadas para tratamiento” [Continue orienting and by referring pregnant women to treatment],” “Consider referring patients for pre-exposure prophylaxis,” “Increase referrals to GYN for contraceptive management,” and “More referrals for specialty mental health attention.”