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Evaluating the impact of a multicountry interprofessional training programme to improve HIV knowledge and clinical confidence among healthcare workers in sub-Saharan Africa: a cohort study

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ABSTRACT

Objective To assess the impact of an interprofessional case-based training programme to enhance clinical knowledge and confidence among clinicians working in high HIV-burden settings in sub-Saharan Africa (SSA).

Setting Health professions training institutions and their affiliated clinical training sites in 12 high HIV-burden countries in SSA.

Participants Cohort comprising preservice and in-service learners, from diverse health professions, engaged in HIV service delivery.

Intervention A standardised, interprofessional, case-based curriculum designed to enhance HIV clinical competency, implemented between October 2019 and April 2020.

Main outcome measures The primary outcomes measured were knowledge and clinical confidence related to topics addressed in the curriculum. These outcomes were assessed using a standardised online assessment, completed before and after course completion. A secondary outcome was knowledge retention at least 6 months postintervention, measured using the same standardised assessment, 6 months after training completion. We also sought to determine what lessons could be learnt from this training programme to inform interprofessional training in other contexts.

Results Data from 3027 learners were collected: together nurses (n=1145, 37.9%) and physicians (n=902, 29.8%) constituted the majority of participants; 58.1% were preservice learners (n=1755) and 24.1% (n=727) had graduated from training within the prior year. Knowledge scores were significantly higher, postparticipation compared with preparticipation, across all content domains, regardless of training level and cadre (all p<0.05). Among 188 learners (6.2%) who retook the test at >6 months, knowledge and self-reported confidence scores were greater compared with precourse scores (all p<0.05).

Conclusion To our knowledge, this is the largest interprofessional, multicountry training programme established to improve HIV knowledge and clinical confidence among healthcare professional workers in SSA. The findings are notable given the size and geographical reach and demonstration of sustained confidence and knowledge retention post course completion. The findings highlight the utility of interprofessional approaches to enhance clinical training in SSA.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is a large cohort study evaluating the impact of a novel training intervention and includes over 3000 learners from across 12 sub-Saharan African (SSA) countries.
⇒ To assess retention of knowledge and clinical confidence over time, knowledge and confidence in a subset of learners were reassessed at least 6 months after participating in the training intervention.
⇒ The analysis does not indicate a causal relationship between the intervention and the outcome nor does it provide insights into whether the intervention led to improvements in clinical care.
⇒ The training programme evaluated offers a scalable model for interprofessional HIV training healthcare workers in diverse settings in SSA.

BACKGROUND

Sub-Saharan Africa (SSA) faces diverse health challenges, including the persistent burden of infectious diseases like HIV and tuberculosis (TB), an increasing burden of non-communicable diseases,[1] and new health challenges arising from climate change. The COVID-19 pandemic has undermined efforts to address many of these challenges[2] and will likely continue to impact service delivery for years to come. There is a critical need to invest in and ensure a health workforce[3] with an

appropriate skill mix can address these numerous health challenges and close gaps in healthcare in SSA. Despite estimates that Africa will have a shortage of 6 million health workers by 2030, there are positive signs.[4] Research in diverse African settings has highlighted how interprofessional training programmes can play a critical role in optimising scarce human resources and enhancing the quality of care delivered, including enhancing training for preservice learners, such as nursing and medical students.[5 6] Furthermore, recent research has highlighted how optimised team-based approaches to healthcare training can improve the quality of care provided, including in high HIV burden settings.[7–9]

Global initiatives, such as the Medical Education Partnership Initiative and the Nursing Education Partnership Initiative programmes, have contributed to recent cross-country collaborations to improve health professions training, for both preservice and in-service learners.,[10–12] In previous work, we have described the design and implementation of one such initiative—the STRIPE HIV (STRengthening InterProfessional Education for HIV) programme—funded by the US Health Resources Services Administration, with the goal to optimise team-based HIV care, using case-based, interprofessional approaches to learning.[13] This training programme consists of approximately 14 hours of modular case-based curriculum, typically taught over 2 days, addressing core components of HIV prevention, care and treatment, targeted at early career in-service health professionals ('postgraduates') and preservice learners in 14 high HIV burden countries in SSA. The objective of this analysis was to evaluate the impact of the STRIPE HIV programme, with specific attention to whether this interprofessional approach enhanced retention of HIV knowledge and confidence to deliver high-quality care, including >6 months after course participation. In addition to evaluating the impact of the training on learners across SSA, an important subsidiary goal of our evaluation was to determine what lessons could be learnt from this unique multicountry training programme to inform interprofessional training programmes in other contexts.

METHOD

The study was conducted using data from the STRIPE HIV programme. The programme was launched across 20 health professions training institutions in 14 countries in October 2019. All learners who completed a pretest and post-test assessment for an in-person training conducted between 1 October 2019 and 31 March 2020, were included in the study. After April 2020, all training transitioned to online format given widespread restrictions on in-person learning related to the COVID-19 pandemic; these learners were excluded from this analysis. As previously described, training included 17 case-based modules, typically presented over 2 days, and was designed to foster interprofessional discussion and facilitate learning related to HIV clinical management, quality improvement and interprofessional collaborative practice. Training content included required modules on initiating HIV therapeutics in women of childbearing age ('HIV and Women'), management of opportunistic infections ('HIV-TB'), prevention of mother to child transmission and paediatric HIV ('Paediatric Care'), in which all learners participated regardless of the stage of their career or professional cadre. These modules were all created by the study team which included local HIV practitioners and international and local educational experts. In addition to creation of the learning materials, the study team provided local educators at each partner institution with training resources to implement the course. These local partners were encouraged to ensure that each training course included a diverse mix of professional cadres and, where feasible, a mix of health professionals at different stages of their career (preservice, postgraduate but within 12 months of graduation and greater than 12 months postgraduation). The study team also provided training resources to facilitate training of local facilitators. The frequency of training courses offered, the ratio of learners to facilitators, mix of cadres and course timing were all determined by local partner institutions. Given scarcity of training resources, some health professions training institutions had to decline access for eligible candidates; in such circumstances, participation of early career professionals was prioritised over preservice learners.

Cohort

This was a convenience sample, including all learners who participated in the STRIPE HIV training programme and had completed both pretraining and posttraining assessments during the study period. In addition to capturing learner demographic information, the assessment assessed learner (1) clinical and technical knowledge related to the learning objectives outlined in the programme and (2) self-reported confidence in skills and abilities covered in the programme, including (A) confidence to participate in HIV service delivery, specific to each cadre's scope of practice, in the domains addressed in the course, (B) confidence to employ quality improvement tools and (C) confidence to practice as part of an interprofessional team. Knowledge was assessed using a series of domain-specific multiple-choice questions; all questions were the same for all participants regardless of training context, participant cadre, training institution and country. Confidence was assessed on a four-point Likert-type scale, ranging from 1= 'I feel uncomfortable with this topic/need supervision from my supervisor' to 4= 'I feel very comfortable with this topic/without supervision as though in independent practice' (online supplemental appendices 1; 2).

All learners completed the initial assessment at the time of programme enrollment, typically within 24 hours of starting training. They then completed the same assessment immediately after completing the course, typically within 48 hours. For most participants, these pre and post programme assessments were accessed on the training

programme's website. However, for a small subset that did not have internet or computer access, assessments were completed on paper, and subsequently uploaded into the project database by local research staff. Starting in October 2020, we invited all participants to retake the same assessment at least 6 months after when they had participated in the programme. This repeat assessment was administered electronically via email (Qualtrics, version XM; Provo, Utah; 2013). To increase uptake of this repeat assessment, all individuals who completed it were entered into a lottery to receive a US$50 prize voucher for internet data or airtime.

Analysis

Data were aggregated and deidentified and is published on Dryad.[14] We only included data on learners for whom we had both precourse and postcourse assessment data, excluding those participants for whom we did not have both data points. For these eligible learners, we used descriptive statistics to summarise demographic characteristics of programme participants, stratifying results by gender, health profession cadre and professional career stage (RStudio V.1.3.1093). We separately analysed (1) differences in precourse and postcourse knowledge and self-reported confidence using Wilcoxon signed-rank tests and (2) differences in knowledge and self-reported confidence between cadres and career stage using analysis of variance and Tukey's HSD (honestly significant difference) test. For the subgroup of learners for whom both precourse and postcourse assessment results were available, and who had also completed the postcourse assessment >6 months after completion of the course, we calculated the change in levels of knowledge and self-reported confidence between the post >6 months assessment and the precourse assessment sores using Wilcoxon signed-rank test. We applied Wilcoxon signed-rank tests because distributions of assessment response variables were not normally distributed. All reported p values were two sided.

Patient and public involvement

The design of the training programme, including the topics covered and the format of the training, was informed by input from focus-group discussions with patient groups, learners (both preservice and early career professionals) and HIV educators from a variety of settings in SSA, and has been previously described.[13] Assessment tools, evaluating learners knowledge and confidence, were also piloted with a subset of multidisciplinary learners before the full programme was launched. All learners were given access to their prescore and postscore test results, via the programme's website. In addition, aggregate, site-level evaluation data were also posted on the programme's website.

Table 1 Demographic summary of all study participants (n=3027)

	No	(%)
Gender identity	3023	(100.0)
Male	1281	(42.4)
Female	1570	(51.9)
Additional	172	(5.7)
Current training level	3022	(100.0)
Preservice student	1755	(58.1)
Postgraduate new provider (within 12 months of graduation)	727	(24.1)
Postgraduate (beyond 12 months of graduation)	540	(17.9)
Current health profession	**3023**	(**100.0**)
Medical	902	(29.8)
Nursing/midwifery	1145	(37.9)
Pharmacy	312	(10.3)
Laboratory	365	(12.1)
Other	299	(9.9)
Country	3022	(100.0)
Botswana	174	(5.8)
Ethiopia	50	(1.7)
Ghana	733	(24.3)
Kenya	1	(0.0)
Lesotho	130	(4.3)
Malawi	512	(16.9)
Nigeria	192	(6.4)
South Africa	323	(10.7)
Tanzania	50	(1.7)
Uganda	635	(21.0)
Zambia	110	(3.6)
Zimbabwe	112	(3.7)

RESULTS

Between October 2019 and April 2020, 5027 learners participated in the STRIPE HIV training programme. Of these 3027 (60.2%) learners completed both precourse assessment and the postcourse assessment and were included in the study. Of those included in the study 51.9% (n=1570) were women (table 1). Learners from 12 countries were included in the analysis with Ghana contributing the largest number (n=733, 24.3%). The majority of learners were still in preservice training when they participated (58.1%, n=1755); a smaller number were health professionals who had graduated within the past twelve months (24.1%, n=727), and the remainder were health professionals who had been practicing clinically for more than twelve months (17.9%, n=540). Nursing and midwife professionals constituted the largest group of learners, (37.9%, n=1145), followed by medical

Table 2 Participant knowledge scores, stratified by clinical domain, gender, training level and cadre

	N	Maximum score	Mean pre-score*		Mean post-score*		Mean difference*		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value
Clinical domain									
HIV and women	3027	4	3.4(0.8)	(85.0)	3.7(0.6)	(92.5)	0.3(0.8)	(7.5)	<0.0001
HIV-TB		5	2.7(1.1)	(54.0)	3.4(1.1)	(68.0)	0.7(1.2)	(14.0)	<0.0001
PMTCT		4	3.1(0.9)	(77.5)	3.3(0.8)	(82.5)	0.3(0.9)	(7.5)	<0.0001
Paediatric care		4	1.4(1.0)	(35.0)	2.1(1.1)	(52.5)	0.7(1.2)	(17.5)	<0.0001
Total score		17	10.5(2.4)	(61.8)	12.4(2.5)	(72.9)	2.0(2.5)	(11.8)	<0.0001
Gender	3023	17							
Male	1281		10.7(2.4)	(62.9)	12.6(2.5)	(74.1)	1.9(2.5)	(11.2)	<0.0001
Female	1570		10.3(2.3)	(60.6)	12.3(2.4)	(72.4)	2.0(2.5)	(11.8)	<0.0001
Additional	172		10.7(2.4)	(62.9)	12.3(2.3)	(72.4)	1.6(2.3)	(9.4)	<0.0001
Training level	3022	17							
Preservice	1755		10.1(2.3)	(59.4)	12.1(2.5)	(71.2)	2.0(2.6)	(11.8)	<0.0001
Postgrad <12 months	727		10.7(2.5)	(62.9)	12.7(2.4)	(74.7)	2.0(2.3)	(11.8)	<0.0001
Postgrad >12 months	540		11.4(2.4)	(67.1)	13.1(2.2)	(77.1)	1.7(2.2)	(10.0)	<0.0001
Health profession	3023	17							
Medical	902		11.6(2.2)	(68.2)	13.2(2.2)	(77.6)	1.6(2.1)	(9.4)	<0.0001
Nursing/midwifery	1145		9.9(2.3)	(58.2)	12.0(2.5)	(70.6)	2.1(2.5)	(12.4)	<0.0001
Laboratory	365		9.6(2.2)	(56.5)	12.4(2.4)	(72.9)	2.8(2.7)	(16.5)	<0.0001
Pharmacy	312		11.0(2.2)	(64.7)	12.6(2.1)	(74.1)	1.6(2.3)	(9.4)	<0.0001
Other	299		9.8(2.5)	(57.6)	11.4(2.8)	(67.1)	1.6(3.0)	(9.4)	<0.0001

Preservice student=a learner enrolled in a university and working towards their degree, postgraduate <12 months=an in-service learner who graduated from health professions training within the last 12 months; postgraduate >12 months=an in-service learner who graduated from health professions training more than 12 months earlier. Wilcoxon signed-rank test used for statistical comparison throughout.
*Scores identified as both a total number and the per cent score out of the maximum score; Scores calculated as sum of correct responses to assessment questions with each correct answer equal to 1 point.
PMTCT, prevention of mother to child transmission; TB, tuberculosis.

(29.8%, n=902) and laboratory professionals (12.1%, n=365). The average time between precourse and postcourse assessments was 2.5 days, with 2764 individuals completing the postcourse assessment 0–7 days after their precourse assessment (93%) and 198 completing after 7 or more days (6.5%).

Assessing the impact of knowledge

Precourse knowledge of paediatric HIV was lowest for all learners (mean score, 1.4, 35%), and highest for the module on HIV and women (mean score 3.4, 85%). Across all clinical domains assessed, there was a significant improvement in knowledge between precourse and postcourse assessment results (table 2 and online supplemental figure 1). Moreover, these improvements were significant for all training levels and all health profession cadres. The smallest incremental increase in aggregate knowledge scores was noted for postgraduate learners who had been in practice for more than twelve months (mean difference 1.7, 10%) and for medical (mean difference 1.6, 9.4%), pharmacy (mean difference 1.6, 9.4%) and other professionals (mean difference 1.6, 9.4%), compared with nursing/midwifery (mean difference 2.1, 12.4%) and laboratory professionals (mean difference 2.8, 16.5%). Medical professionals had the highest precourse and postcourse assessment scores, but the greatest increase in knowledge scores was among laboratory professionals. There was a significantly smaller increase in knowledge scores among learners who had been in practice for more than twelve months compared with either the preservice trainees or those who had graduated within the prior twelve months (mean difference 1.7, 10% vs 2.0, 11.8% vs 2.0, 11.8%, respectively).

Assessing impact on clinical confidence

Comparing pre-Likert and post-Likert scores for each of the three dimensions of confidence assessed, there were significant improvements in self-reported confidence after the course, for all participants across all health profession cadres. The greatest increases in self-reported confidence between precourse and postcourse assessments were for medical professionals (table 3, figure 1 and online supplemental figure 1).

Assessing knowledge and self-confidence retention over time

A subset of participants (6.2%, n=188) retook the assessment at least 6 months after the pre-course assessment. Most of these participants retook the test between 6 and

Table 3 Participants' mean confidence scores, stratified by clinical domain and cadre

	N	Maximum score	Mean prescore*		Mean postscore*		Mean difference*		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value
Clinical confidence†	3028	60	41.4(9.3)	(69.0)	53.4(7.3)	(88.9)	12.1(9.3)	(20.2)	<0.0001
Health profession									
Medical	902		41.7(9.1)	(69.6)	54.8(6.4)	(91.3)	13.0(8.9)	(21.7)	<0.0001
Nursing/midwifery	1145		40.6(9.3)	(67.7)	52.9(7.7)	(88.1)	12.3(9.4)	(20.5)	<0.0001
Pharmacy	312		42.2(9.2)	(70.4)	53.6(6.6)	(89.3)	11.4(9.0)	(18.9)	<0.0001
Laboratory	365		41.2(10.0)	(68.7)	51.7(7.7)	(86.2)	10.5(9.9)	(17.6)	<0.0001
Other	299		43.0(8.9)	(71.7)	51.9(8.3)	(86.5)	8.9(8.7)	(14.9)	<0.0001
Gender									
Male	1281		42.8(9.0)	(71.3)	53.8(7.2)	(89.7)	11.0(9.1)	(18.4)	<0.0001
Female	1570		40.2(9.5)	(67.0)	53.0(7.4)	(88.3)	12.8(9.4)	(21.3)	<0.0001
Additional	172		42.0(8.2)	(70.0)	53.3(7.4)	(88.9)	11.3(8.5)	(18.9)	<0.0001
Training level									
Preservice	1755		41.1(9.2)	(68.5)	53.0(7.5)	(88.4)	11.9(9.2)	(19.8)	<0.0001
Postgraduate <12 months	727		41.2(9.3)	(68.6)	53.6(7.1)	(89.3)	12.4(9.4)	(20.7)	<0.0001
Postgraduate >12 months	540		42.7(9.6)	(71.2)	54.1(6.9)	(90.1)	11.4(9.2)	(19.0)	<0.0001
Confidence working as part of an IP team‡	3028	8	5.9(1.5)	(73.2)	7.3(1.0)	(90.8)	1.4(1.5)	(17.7)	<0.0001
Health profession									
Medical	902		5.6(1.5)	(70.3)	7.4(1)	(91.9)	1.7(1.5)	(21.6)	<0.0001
Nursing/midwifery	1145		5.9(1.5)	(73.8)	7.2(1.1)	(90.3)	1.3(1.5)	(16.5)	<0.0001
Pharmacy	312		6.1(1.5)	(75.7)	7.4(0.9)	(92.5)	1.3(1.5)	(16.9)	<0.0001
Laboratory	365		5.9(1.6)	(74.3)	7.2(1.1)	(89.6)	1.2(1.6)	(15.3)	<0.0001
Other	299		6.1(1.4)	(76.1)	7.1(1.1)	(88.9)	1.0(1.3)	(12.8)	<0.0001
Gender									
Male	1281		6.0(1.5)	(74.8)	7.3(1.0)	(91.4)	1.3(1.5)	(16.5)	<0.0001
Female	1570		5.7(1.6)	(71.9)	7.2(1.0)	(90.4)	1.5(1.6)	(18.5)	<0.0001
Additional	172		5.9(1.5)	(73.5)	7.3(1.1)	(90.6)	1.4(1.6)	(17.1)	<0.0001
Training level									
Preservice	1755		5.8(1.6)	(73.0)	7.3(1.0)	(90.5)	1.4(1.6)	(17.6)	<0.0001
Postgraduate <12 months	727		5.8(1.5)	(73.0)	7.2(1.0)	(90.6)	1.4(1.5)	(17.5)	<0.0001
Postgraduate >12 months	540		6.0(1.5)	(74.3)	7.4(1.0)	(92.0)	1.4(1.5)	(17.6)	<0.0001
Confidence implementing QI‡	3028	8	4.5(1.9)	(56.7)	7.2(1.1)	(89.5)	2.6(2.0)	(33.1)	<0.0001
Health profession									
Medical	902		4.2(1.9)	(52.4)	7.2(1.1)	(90.4)	3.0(2.0)	(38.0)	<0.0001
Nursing/midwifery	1145		4.5(1.8)	(56.0)	7.1(1.2)	(89.0)	2.6(1.9)	(33.0)	<0.0001
Pharmacy	312		4.7(1.9)	(58.3)	7.2(1.0)	(89.6)	2.5(1.9)	(31.3)	<0.0001
Laboratory	365		5.0(1.9)	(63.0)	7.1(1.1)	(89.3)	2.1(1.9)	(26.2)	<0.0001
Other	299		5.1(1.8)	(64.3)	7.1(1.1)	(88.8)	2.0(1.9)	(24.5)	<0.0001
Gender									
Male	1281		4.8(1.9)	(59.6)	7.2(1.1)	(90.4)	2.5(2.0)	(30.7)	<0.0001
Female	1570		4.3(1.9)	(53.9)	7.1(1.1)	(88.7)	2.8(2.0)	(34.8)	<0.0001
Additional	172		4.7(1.9)	(59.1)	7.3(1.1)	(90.7)	2.5(2.1)	(31.7)	<0.0001
Training level									
Preservice	1755		4.5(1.9)	(56.7)	7.1(1.2)	(89.1)	2.6(2.0)	(32.5)	<0.0001

Continued

Table 3 Continued

	N	Maximum score	Mean prescore*		Mean postscore*		Mean difference*		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value
Postgraduate <12 months	727		4.4(1.9)	(55.5)	7.2(1.1)	(89.6)	2.7(2.0)	(34.1)	<0.0001
Postgraduate >12 months	540		4.6(1.9)	(58.0)	7.2(1.0)	(90.6)	2.6(2.0)	(32.6)	<0.0001

Preservice student=a learner enrolled in a university and working towards their degree, postgraduate <12 months=an in-service learner who graduated from health professions training within the last 12 months; postgraduate >12 months=an in-service learner who graduated from health professions training more than 12 months earlier. Wilcoxon signed-rank test used for all statistical comparisons.
*Scores identified as both a total number and the percent score out of the maximum score.
†Mean score of 15 questions asked on a Likert scale of 1 ('I feel uncomfortable with this topic/need supervision from my supervisor') to 4 ('I feel very comfortable with this topic/without supervision as though in independent practice').
‡Mean score of 2 questions asked on a Likert scale of 1 ('I feel uncomfortable with this topic/need supervision from my supervisor') to 4 ('I feel very comfortable with this topic/without supervision as though in independent practice'.
IP, interprofessional; QI, quality improvement.

12 months later (71.3%, n=134); the remainder retook it 12–16 months after participating in the training (28.7%, n=54). Those who retook the test at least 6 months later were similar to the overall study cohort, in terms of gender, cadre and stage of training. Notably, there was a small but significant diminution in scores between the post-test assessment immediately after the course, and then >6 months later, across all training content and

Figure 1 Prelearner and postlearner assessments of confidence (A) clinical confidence, (B) confidence engaging in interprofessional collaboration and (C) confidence using quality improvement tools. ART, Anti-Retroviral Therapy; TB, tuberculosis; TPT, Tuberculosis Preventive Therapy.

for all cadres, regardless of stage of learning. However, knowledge scores were significantly higher at >6 months than precourse scores across all content domains for all participants; these differences were significantly greater for preservice trainees but not for graduate professionals in practice <12 months (table 4 and online supplemental figuers 2 and 3). Higher knowledge scores at >6 months were noted for all cadres except medical professionals (p=0.66) and other (p=0.48).

For all learners, self-reported confidence to work as part of an interprofessional team and to employ QI tools in clinical practice were significantly greater at >6 months than at the time of precourse assessment completion (table 5). When stratified by cadre, confidence scores in each of these domains were also significantly greater at >6 months compared with precourse participation for medical (n=51), nursing (n=66) and pharmacy professionals (n=34), but not laboratory professionals (n=29).

DISCUSSION

This study highlights the impact of an interprofessional training programme to enhance HIV knowledge and self-reported confidence among over 3000 learners in 14 countries in SSA. The training intervention was associated with significantly greater knowledge scores and confidence levels for all learners, regardless of health profession cadre. Moreover, across diverse cadres, this impact was sustained over time, as evidenced by superior knowledge scores and self-reported confidence at more than 6 months post-course completion. Outlined below are the most salient conclusions, which have broad application to other training interventions and geographical regions.

First, the study suggests that interprofessional approaches to education may contribute to sustained improvements in knowledge and clinical confidence for all cadres. While notable that the greatest improvements in knowledge scores were among laboratory scientists, perhaps a reflection of the limited clinical and treatment material that they are exposed to during training, improvements in knowledge were noted for learners from all health profession cadres and regardless of stage of training. These data provide compelling evidence of the impact of interprofessional training programmes to enhance HIV-related clinical knowledge skills. While we are unable to determine what specific elements of our educational interventions were maximally effective, the findings do validate existing data highlighting the utility of interprofessional approaches to teach other clinical competencies and/or domains of practice in SSA.[15–17] This has critical policy implications, especially given the potential cost saving and pedagogical efficiencies afforded by interprofessional learning approaches to health professions education.[18] Given that nurses and midwives play such a critical role as part of Africa's frontline primary care workforce, and were the largest grouping in our analysis, we assert that this training intervention offers a model for optimising nursing and midwifery training that can enhance team-based clinical care. Such an approach to training challenges entrenched, hierarchical approaches to clinical education that are commonplace in SSA; in many countries in SSA, training for medical, nursing and other allied health professional students is siloed, especially at the preservice level.[19] While not formally evaluated in our analysis, we assert that interprofessional approaches to education can also inform and enhance team-based care, including optimising use of resources and expertise especially in health systems with scarce human resources for health.[18 20 21]

Second, the analysis indicates that knowledge and self-reported confidence levels 6 months after participation were still higher than precourse levels although only in a small subset of learners. Evidence of knowledge and confidence retention should be interpreted with caution, given that numerous other factors may have contributed to why these learners were more knowledgeable and reported more confidence 6–16 months later than they were before participating in the programme. Nonetheless, the findings support academic literature from other settings, including high-income countries, where case-based or simulation initiatives have been shown to be effective in enhancing knowledge retention even several months later.[22–25] While more research is warranted to better understand determinants of knowledge and confidence retention, our findings should inform how this kind of training is deployed to support learners in transition from preservice to independent clinical practice where the dividends of retained knowledge are likely to be high.[26] The modules used in this programme were a case-based format, which may contribute to the higher probability of retention since evidence suggests case-based learning using clinical scenarios is especially effective in enhancing knowledge retention.[27 28]

Third, the results underscore how case-based, interprofessional approaches to learning can be successfully leveraged to support HIV training programmes in resource-variable settings, and for both preservice and in-service learners, especially in settings where existing HIV training efforts were inadequate or non-existent. We note that the improvements in knowledge were smaller in postgraduate learners compared with preservice learners and assume that this observation is explained by virtue of the fact that these experienced learners had superior knowledge at baseline. Nonetheless, training positively impacted knowledge and confidence for these more experienced learners too. Moreover, the training programme successfully leveraged an extensive network of training institutions across numerous countries to deliver high quality, standardised training, while allowing for contextual adaptation and flexible approaches to the delivery of modules based on local situations. As such it offers a useful model for how to rapidly and effectively train health professionals across SSA to respond to current and emerging public health and clinical challenges, including future pandemic threats.[29] Ongoing cross-country

Table 4 Comparison of knowledge scores before and 6 months after course participation, among learners who completed the assessment >6 months after course completion (n=188), stratified by clinical domain, gender, training level and cadre

	N	Max score*	Mean pre score		Mean post score		Mean post score >6 month		Pre versus post score >6 month Mean diff†			Post versus post score >6 month Mean diff†		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value	Mean (SD)	(%)	P value
Clinical domain	188													
HIV and women		4	3.4(0.8)	(84.3)	3.7(0.5)	(93.3)	3.6(0.7)	(89.8)	0.2(0.9)	(5.5)	<0.001	−0.1(0.7)	(−3.6)	0.010
HIV-TB		5	2.8(1.1)	(56.1)	3.5(1.0)	(70.4)	3.2(1.1)	(64.7)	0.4(1.3)	(8.6)	<0.0001	−0.3(1.1)	(−5.7)	0.002
PMTCT		4	3.2(0.9)	(80.2)	3.5(0.7)	(87.8)	3.4(0.7)	(85.1)	0.2(1.0)	(4.9)	0.007	−0.2(0.8)	(−2.7)	0.090
Paediatric care		4	1.5(1.0)	(36.3)	2.1(1.2)	(52.3)	1.9(1.2)	(47.8)	0.5(1.4)	(11.4)	<0.0001	−0.2(1.4)	(−4.5)	0.099
Total score		17	10.8(2.4)	(63.7)	12.9(2.1)	(75.6)	12.1(2.6)	(71.4)	1.3(2.9)	(7.7)	<0.0001	−0.7(2.6)	(−4.2)	<0.001
Gender		17												
Male	87		10.8(2.5)	(63.2)	12.8(2.3)	(74.9)	12.3(2.5)	(72.3)	1.5(2.6)	(9.1)	<0.0001	−0.4(2.7)	(−2.6)	0.256
Female	98		10.9(2.3)	(64.2)	13.0(1.9)	(76.4)	12.1(2.6)	(70.9)	1.1(3.1)	(6.7)	0.001	−0.9(2.5)	(−5.5)	<0.001
Additional	3		10.6(3.4)	(62.3)	11.8(2.0)	(69.6)	10.3(2.0)	(60.8)	−0.3(1.9)	(−1.5)	0.750	−1.5(1.3)	(−8.8)	0.250
Training level		17												
Preservice	120		10.3(2.3)	(60.5)	12.5(2.0)	(73.3)	11.9(2.8)	(70.0)	1.6(3.2)	(9.5)	<0.0001	−0.6(2.8)	(−3.3)	0.072
Postgraduate <12 months	43		11.7(2.5)	(68.6)	13.4(2.2)	(78.7)	12.3(2.1)	(72.3)	0.6(2.2)	(3.8)	0.074	−1.1(2.4)	(−6.3)	0.008
Postgraduate >12 months	25		12.1(1.6)	(71.1)	13.9(1.8)	(81.8)	13.0(2.1)	(76.6)	0.9(1.8)	(5.5)	0.019	−0.9(1.9)	(−5.2)	0.035
Health profession		17												
Medical	51		12.1(2.2)	(71.4)	13.7(2.0)	(80.4)	12.4(2.3)	(73.2)	0.3(2.6)	(1.8)	0.680	−1.2(2.0)	(−7.2)	<0.001
Nursing/midwifery	66		10.6(2.3)	(62.1)	12.7(1.8)	(74.7)	11.9(2.2)	(69.9)	1.3(2.6)	(7.8)	<0.001	−0.8(2.3)	(−4.8)	0.010
Laboratory	29		9.6(2.5)	(56.7)	12.3(2.6)	(72.3)	11.6(3.4)	(68.3)	2.0(3.4)	(11.6)	0.004	−0.7(3.4)	(−4.0)	0.340
Pharmacy	33		10.8(2.0)	(63.7)	12.7(2.0)	(74.3)	13.1(2.5)	(77.0)	2.3(2.8)	(13.3)	<0.001	0.5(2.7)	(2.7)	0.122
Other	9		9.3(2.0)	(54.9)	12.1(1.8)	(71.1)	10.5(2.4)	(61.9)	1.2(3.6)	(7.0)	0.478	−1.6(3.3)	(−9.2)	0.154

Prescore=mean score of knowledge quiz taken before starting the course; Postscore=mean score of knowledge quiz taken immediately after course completion; Postscore >6 months=mean score of knowledge quiz taken 6 months or later after course completion; Preservice student = a learner enrolled in a university and working towards their degree, postgraduate <12 months = an in-service learner who graduated from health professions training within the last 12 months; postgraduate > 12 months = an in-service learner who graduated from health professions training more than 12 months earlier; Diff = difference.
*Each point equates to one (1) question: 4 points = 4 questions, 5 points = 5 questions, 17 points = 17 questions.
†Identifies the mean difference between the post >6 score and the prescore; Wilcoxon signed-rank test used for all statistical comparisons.
PMTCT, prevention of mother to child transmission; TB, tuberculosis.

Table 5 Comparison of confidence scores before and 6 months after course participation, among learners who completed the assessment >6 months after course completion (n=188), stratified by clinical domain and cadre

	N	Max score	Mean pre*		Mean post*		Mean post>6*		Pre versus post>6 Mean Diff*			Post versus Post>6 Mean Diff*		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value	Mean (SD)	(%)	P value
Clinical confidence†	188	60	42.8(8.9)	(71.4)	54.5(6.8)	(90.9)	51.6(7.9)	(86.0)	9.3(8.7)	(15.5)	<0.0001	−3.0(6.8)	(−4.9)	<0.0001
Health profession														
Medical	51		42.1(8.5)	(70.2)	55.1(6.5)	(92.0)	52.4(7.4)	(87.4)	10.6(8.4)	(17.6)	<0.0001	−2.5(7.5)	(−4.2)	0.011
Nursing/ midwifery	66		41.6(8.4)	(69.3)	54.7(7.1)	(91.2)	50.9(8.4)	(84.8)	9.3(8.6)	(15.6)	<0.0001	−3.9(7.0)	(−6.4)	<0.0001
Pharmacy	33		42.5(10.6)	(70.8)	54.9(5.8)	(91.5)	51.8(7.9)	(86.4)	10.0(10.7)	(16.6)	<0.001	−3.9(5.5)	(−6.4)	0.002
Laboratory	29		46.8(7.9)	(77.9)	52.8(7.0)	(88.0)	51.9(6.6)	(86.5)	6.1(7.4)	(10.1)	0.500	−0.6(6.8)	(−1.0)	0.750
Other	9		48.3(9.7)	(80.6)	53.0(10.0)	(88.3)	49.2(12.2)	(81.9)	5.8(6.2)	(9.7)	0.188	−2.7(3.0)	(−4.4)	0.110
Gender														
Male	87		43.6(9.0)	(72.6)	54.9(6.4)	(91.5)	53.0(7.0)	(88.3)	9.6(8.9)	(16.0)	<0.0001	−2.0(6.8)	(−3.4)	<0.001
Female	98		41.8(8.8)	(69.6)	54.1(7.3)	(90.2)	50.3(8.5)	(83.9)	9.5(8.5)	(15.8)	<0.0001	−3.6(6.7)	(−6.0)	<0.0001
Additional	3		51.7(6.8)	(86.1)	58.3(2.9)	(97.2)	49.0(9.6)	(81.7)	−2.7(6.0)	(−4.4)	0.750	−9.3(8.1)	(−15.6)	0.370
Training level														
Preservice	120		42.9(9.5)	(71.5)	54.1(7.1)	(90.2)	51.4(8.1)	(85.7)	9.2(8.9)	(15.4)	<0.0001	−2.6(6.7)	(−4.3)	<0.0001
Postgrad <12 months	43		42.6(8)	(71.1)	55.5(6.2)	(92.5)	52.1(7.6)	(86.8)	9.9(9.5)	(16.5)	<0.0001	−3.6(7.1)	(−5.9)	<0.001
Postgrad >12 months	25		42.9(6.2)	(71.5)	54.9(6.1)	(91.5)	51.5(7.2)	(85.8)	8.5(6.6)	(14.2)	<0.001	−3.7(6.9)	(−6.2)	0.042
Confidence working as part of an IPE team‡	188	8	6.1(1.5)	(76.4)	7.4(1.0)	(92.1)	7.0(1.1)	(88.1)	1.0(1.6)	(11.9)	<0.0001	−0.3(1.2)	(−3.9)	<0.001
Health profession														
Medical	51		5.6(1.5)	(70.6)	7.4(1.1)	(92.0)	7.0(1.0)	(87.7)	1.4(1.6)	(17.2)	<0.0001	−0.3(1.2)	(−4.3)	0.047
Nursing/ midwifery	66		6.3(1.5)	(78.6)	7.4(1.0)	(92.2)	7.0(1.1)	(87.1)	0.7(1.6)	(9.3)	<0.001	−0.4(1.2)	(−5.1)	0.013
Pharmacy	33		6.2(1.6)	(77.0)	7.5(76.1)	(94.1)	7.1(1.1)	(89.8)	1.1(1.7)	(13.3)	0.004	−0.4(0.9)	(−4.7)	0.041
Laboratory	29		6.4(1.5)	(79.9)	7.3(1.1)	(90.6)	7.2(0.9)	(89.8)	0.6(1.3)	(7.9)	0.021	−0.1(1.1)	(−0.9)	0.750
Other	9		6.5(1.7)	(81.3)	1.0(1.4)	(87.5)	6.9(1.4)	(86.1)	0.6(1.7)	(7.8)	0.420	0.1(1.4)	(1.6)	1.000
Gender														
Male	87		6.0(1.5)	(74.7)	7.4(0.9)	(92.4)	7.2(0.9)	(89.8)	1.2(1.6)	(15.3)	<0.0001	−0.2(1.0)	(−2.8)	0.053
Female	98		6.2(1.5)	(77.2)	7.3(1.1)	(91.4)	6.9(1.2)	(86.5)	0.8(1.6)	(9.5)	<0.0001	−0.4(1.3)	(−4.8)	0.008
Additional	3		8.0(0.0)	(1.0)	8.0(0.0)	(100.0)	7.3(1.2)	(91.7)	−0.7(1.2)	(−8.3)	1.000	−0.7(1.2)	(−8.3)	1.000
Training level														

Continued

Table 5 Continued

	N	Max score	Mean pre*		Mean post*		Mean post>6*		Pre versus post>6Mean Diff*			Post versus Post>6Mean Diff*		
			Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	Mean (SD)	(%)	P value	Mean (SD)	(%)	P value
Preservice	120		6.2(1.6)	(77.8)	7.3(1.0)	(91.6)	7.1(1.1)	(88.2)	0.8(1.6)	(10.5)	<0.0001	−0.3(1.1)	(−3.2)	0.023
Postgrad <12 months	43		6.0(1.4)	(74.4)	7.4(1.1)	(92.4)	7.0(1.0)	(87.8)	1.2(1.7)	(14.4)	<0.001	−0.4(1.2)	(−4.6)	0.068
Post-grad >12 months	25		5.8(1.3)	(73.0)	7.5(1.0)	(93.8)	7.0(1.1)	(88.0)	1.2(1.2)	(15.0)	<0.001	−0.5(1.3)	(−6.3)	0.058
Confidence implementing QI‡	188	8	4.6(2.0)	(57.7)	7.3(1.1)	(91.6)	6.6(1.4)	(82.8)	2.1(1.9)	(25.7)	<0.0001	−0.7(1.2)	(−8.7)	<0.0001
Health profession														
Medical	51		4.2(1.9)	(52.5)	7.3(1.1)	(91.3)	6.5(1.4)	(80.6)	2.3(1.9)	(28.3)	<0.0001	−0.8(1.4)	(−10.5)	<0.001
Nursing/ midwifery	66		4.1(1)	(51.1)	7.2(1.1)	(90.4)	6.6(1.4)	(82.6)	2.6(1.8)	(33.1)	<0.0001	−0.6(1.1)	(−7.5)	<0.0001
Pharmacy	33		4.8(2.0)	(60.1)	7.5(1.1)	(93.6)	6.5(1.6)	(81.8)	1.7(1.7)	(21.4)	<0.0001	−0.9(1.2)	(−11.7)	0.071
Laboratory	29		6.1(1.5)	(76.6)	7.4(0.8)	(93.1)	7.1(1.0)	(88.4)	1.0(1.6)	(13.0)	0.006	−0.4(1.0)	(−4.6)	0.071
Other	9		6.2(2.2)	(77.1)	7.3(1.0)	(90.6)	6.8(1.2)	(84.4)	0.5(1.2)	(6.3)	0.414	−0.6(0.8)	(−7.1)	0.174
Gender														
Male	87		4.9(2.0)	(60.9)	7.4(1.0)	(92.0)	6.8(1.2)	(84.4)	1.9(1.8)	(23.8)	<0.0001	−0.6(1.2)	(−7.6)	<0.0001
Female	98		4.3(2.0)	(54.0)	7.3(1.1)	(91.0)	6.5(1.5)	(81.1)	2.2(1.9)	(27.9)	<0.0001	−0.8(1.2)	(−9.7)	<0.0001
Additional	3		6.3(1.5)	(79.2)	8.0(0.0)	(100.00)	7.3(1.2)	(91.7)	1.0(2.6)	(12.5)	0.586	−0.7(1.2)	(−8.3)	1.000
Training level														
Preservice	120		4.7(2.1)	(58.4)	7.3(1.1)	(91.0)	6.6(1.5)	(83.1)	2.0(1.9)	(25.5)	<0.0001	−0.6(1.2)	(−7.8)	<0.0001
Postgrad <12 months	43		4.4(1.7)	(55.6)	7.4(1.0)	(92.7)	6.7(1.1)	(83.8)	2.3(1.9)	(29.2)	<0.0001	−0.7(1.3)	(−8.8)	0.002
Postgrad >12 months	25		4.6(1.7)	(57.8)	7.4(1.0)	(92.5)	6.4(1.3)	(80.0)	1.7(1.7)	(21.4)	<0.001	−1.0(1.2)	(−12.5)	<0.001

Preservice student = a learner enrolled in a university and working towards their degree, Postgrad <12 months = an in-service learner who graduated from health professions training within the last 12 months; Postgrad >12 months = an in-service learner who graduated from health professions training more than 12 months earlier. Wilcoxon signed-rank test used for all statistical comparisons.
*Scores identified as both a total number and the percent score out of the maximum score.
†Mean score of 15 questions asked on a Likert scale of 1 ('I feel uncomfortable with this topic/need supervision from my supervisor') to 4 ('I feel very comfortable with this topic/without supervision as though in independent practice').
‡Mean score of 2 questions asked on a Likert scale of 1 ('I feel uncomfortable with this topic/need supervision from my supervisor') to 4 ('I feel very comfortable with this topic/without supervision as though in independent practice').
IP, interprofessional; IPE, Interprofessional Education; QI, quality improvement.

coordination across these health professions training institutions and sustained investment in health professions training throughout SSA will be necessary to sustain that capability in the coming years. However, it likely represents a good return on investment if it ensures optimised, high-quality care at the local level, and facilitates standardised, coordinated care at the regional level.[18 30]

Finally, we acknowledge that this study had several limitations; most notably, the data provide limited insights into whether training led to improvements in interprofessional collaborative practices or uptake of quality improvement interventions in clinical practice. Moreover, we acknowledge that our assessment of learners does not include any assessment of their clinical practice or the impact of the training on clinical outcomes. While our findings are clear evidence of substantial increase in average knowledge among learners, further research is necessary to evaluate the clinical impact of these improvements on clinically relevant outcomes. In addition, we have not included qualitative feedback from learners assessing their experience of the training. We also note that only a small number (6.2%) of those who completed the preassessment and postassessment retook the same post assessment >6 months later, and that this subgroup may not be representative of those who completed both the preassessment and postassessment. Given the short interval between precourse and postcourse assessments, our positive results may have been conflated by retrievability bias. Moreover, we do not assume that that improved knowledge and confidence scores in this subset reflect a causal relationship between the intervention and the outcome. Furthermore, data documented in this analysis included only those learners who participated in 'in-person' training that was possible before the onset of the COVID-19 pandemic. Since the start of the pandemic, the training programme has transitioned to an online course; further evaluation is needed to determine whether delivering the same material using online tools is as effective.

CONCLUSIONS

This study highlights the utility of a case-based, interprofessional training programme to enhance HIV knowledge and self-reported confidence among healthcare professionals in diverse settings in 12 countries across SSA. The findings are notable given the size of the study population, the geographical reach of the programme, the inclusion of both preservice and in-service learners, and demonstration of sustained confidence and knowledge retention postcourse completion.

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