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ORIGINAL RESEARCH

Training Course in Focused Assessment with Sonography for HIV/TB in HIV Prevalent Medical Centers in Malawi

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Abstract

Purpose: This article describes the process of training medical providers of different backgrounds about the "focused assessment with sonography for HIV-associated TB" (FASH) exam to expand the availability of ultrasound for TB diagnosis in resource poor settings in the central region of Malawi.

Methods and Materials: A survey was completed by the 19 eligible participants before and after a 4-day training course regarding the utility of the FASH exam. A six-question quiz was used to assess knowledge of the use of ultrasound in the FASH exam before and after the course.

Results: Participants' knowledge of the FASH technique significantly improved after the four-day course with a 32% increase in total quiz questions answered correctly ($p<0.001$). Ninety-five percent (n= 18) of participants answered that they would "likely" incorporate FASH in their clinical practice. Furthermore, 100% (n=19) of participants agreed that the FASH exam would improve their ability to diagnose TB and 95% (n=18) agreed that FASH would improve patient care in their clinic.

Conclusions: After completing a 4-day training course, medical providers were more knowledgeable about the FASH exam and its findings, and felt more comfortable using ultrasound for the diagnosis of TB. Participants were also unanimous in opinion that the FASH ultrasound exam would improve their ability to diagnose TB.

Introduction

In 2015 there were an estimated 10.4 million incident tuberculosis (TB) cases, about a quarter of which were from in Africa (1). Worldwide, 11% of these were in patients who were also infected with human immunodeficiency virus (HIV), but the rate of co-infection was much higher in parts of sub-Saharan Africa. In Malawi, for example, over half of all new TB cases are diagnosed in HIV-positive patients, and as immunosuppression worsens there is a decreased ability for the T cell-mediated immunity to contain the infection (1-3). HIV-infected patients are at high risk of extrapulmonary TB and high mortality if early treatment for TB is not initiated (4). Diagnostic capabilities vary significantly between countries and between different regions within individual countries. Overall, the diagnosis of tuberculosis was confirmed by bacteriologic testing (such as smear microscopy, culture, or

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polymerase chain reaction (PCR) tests) in only 64% of new cases in Africa. The remaining cases were diagnosed clinically based on symptoms, chest X-ray, or histology (1). Diagnosis of extrapulmonary TB is especially challenging, as symptoms can be nonspecific, pathologic samples are more difficult to obtain compared to pulmonary sputum samples, and pathologists and pathology labs are often unavailable in resource-limited settings.

Ultrasound is a portable and inexpensive imaging technique that has expanded diagnostic capacity in resource-limited settings. Prior studies in low- and middle-income countries have shown ultrasound to be a valuable tool with high clinical impact across a spectrum of specialties including obstetrics, cardiac diseases, and infectious diseases, and has been credited to changing clinical management in at least 30% of the patients (5-7). Ultrasound has been found to be a powerful tool in the diagnosis of pulmonary and extrapulmonary TB, where findings can include pericardial effusions, pleural effusions, ascites, enlarged abdominal lymph nodes, and hepatic or splenic lesions (5,8-12). Heller et al. developed a "focused assessment with sonography for HIV-associated TB" (FASH) protocol to evaluate these six findings. The protocol is based on the previously established "focused assessment with sonography for trauma" (FAST) protocol that has been used to evaluate for the presence of internal bleeding in emergency medicine settings (13-14). Additional studies have shown that in a quarter of patients with positive FASH examinations suggestive of extrapulmonary tuberculosis, no signs of tuberculosis are seen on the chest radiograph, thus demonstrating the added value of the FASH examination (10,15). The group then trained three junior hospital physicians in an intense two-day training course including theoretical and case-based lectures, as well as hands-on practicals using healthy individuals and hospital patients. We sought to apply a similar FASH training program to medical providers of different training backgrounds at three sites in Malawi, to expand the availability of ultrasound for TB diagnosis.

Methods and materials

We included three sites in the Central region of Malawi, including one public-private medical center (Partners in Hope Medical Center), one district hospital (Kasungu), and one mission hospital (Madisi). These sites were selected because Partners in Hope provides support to them under a President's Emergency Plan for AIDS Relief (PEPFAR)-United States Agency for International Development (USAID) grant. Participants were eligible if they were certified as a physician, clinical officer, radiographer, or medical assistant. Participants in our study had various levels of training. Clinical Officers in Malawi undergo three years of education at an undergraduate institution followed by a year of clinical internship at a hospital. They receive a Diploma in Clinical Medicine after they have completed these four years successfully. Radiographers in Malawi undergo three years of education, which includes both clinical and lecture-based teaching at an undergraduate institution. They receive a Diploma in Radiography after they have completed these three years successfully. Medical assistants undergo two years of education at an undergraduate institution and receive a certificate in clinical medicine. Medical assistants mainly work at the health center level or at outpatient departments of district hospitals.

All participants completed a four-day course that was offered at Partners in Hope in Lilongwe and taught by two cardiology

Figure 1. Summary of Training Curricula for FASH.

• Baseline survey and pre-training questionnaire • Lecture: Basics of ultrasound physics, terminology, and imaging techniques • Lecture: Introduction to the ultrasound machine, transducers, and knobology • Lecture: The FASH protocol (9 positions) • Practical on FASH protocol using normal models	Morning	Day 1
• Abnormal FASH findings and cases in lecture format • Practical on FASH protocol	Afternoon	
• Practical on FASH protocol	Morning	Day 2
• Practical on FASH protocol	Afternoon	
• Cardiac ultrasound part 1: standard views and left ventricular systolic function • Practical on focused cardiac ultrasound using normal models	Morning	Day 3
• Cardiac ultrasound part 2: valves, Doppler, pericardial effusions, and measurements • Practical on focused cardiac ultrasound	Afternoon	
• Post-training questionnaire • Practical on FASH and focused cardiac ultrasound	Morning	Day 4
• Practical on FASH and focused cardiac ultrasound	Afternoon	

fellows from the University of California, Los Angeles (UCLA), who had received additional training in abdominal ultrasound imaging and the FASH protocol. The first two days of the course focused on teaching and practicing the FASH exam, and the next two days were dedicated to a separate cardiac ultrasound training, with additional time to practice both skills. Nineteen trainees were divided in groups of four to five clinicians for four-week long training sessions. The same lecture slides and curriculum were used by both fellows so that each participant had a similar experience regardless of the course instructor.

The curriculum outline is shown in Figure 1 and was adapted from the previously published experiences using the FASH protocol (13). A multi-disciplinary approach was taken in the development of the protocol, with input from the Departments of Radiology, Cardiology, and Infectious Diseases at UCLA. The training utilized printed reading materials, including the FASH practical manual published by Dr. Heller (14), and printed copies of all lecture material. Electronic copies were also given to each trainee on a USB flash drive, including pictures and video clips from normal ultrasound scans and positive FASH findings. Importantly, the course relied heavily on hands-on practical learning, and most of the day was spent with the trainees practicing FASH using volunteers from the clinic staff or each other as normal models. Ultrasound-guided interventional procedures were not included in the curriculum or hands-on training sessions. All scans were observed by the educators, and assistance and feedback were provided in real time.

Surveys were completed in the morning on the first day prior to the start of training, and again on the final day (see Appendices 1 and 2). Baseline sociodemographic characteristics were obtained from all trainees, including their level of training and experience in managing patients with HIV and TB (Table 1). The survey assessed the clinician's comfort level diagnosing pulmonary and extrapulmonary TB, using ultrasound for medical care, and using ultrasound to diagnose TB before and after the training course. Assessing the clinician's comfort level in diagnosis of pulmonary TB was included in the survey because the FASH exam includes evaluation for pleural effusion, which can be associated with pulmonary TB. In addition, a six-question quiz was used to

Table 1. Sociodemographic characteristics and clinical experience of 19 trainees.

Average age	
32.8 +/- 6.7	
Gender	
Male	17 (89%)
Female	2 (11%)
Education background	
Clinical Officer	9 (47%)
Physician	5 (26%)
Radiography technician	4 (21%)
Medical assistant	1 (5%)
Clinical site	
Partners in Hope	9 (47%)
Madisi	5 (26%)
Kasungu	5 (26%)
Prior experience with ultrasound (US)	
US used to diagnose TB	4 (21%)
US used in obstetrics	15 (79%)
US used to asses abscess	5 (26%)
US used to perform FASH	2 (11%)
Average years of clinical experience	
Total clinical experience	8.4 (Range 2-18)
HIV treatment experience	6.9 (Range 2-16)
TB treatment experience	7.5 (Range 3-23)

Time caring for HIV patients/week	
0-1 day	0 (0%)
1-2 days	1 (5%)
2-3 days	3 (16%)
3-4 days	3 (16%)
4-5 days	10 (53%)
Did not answer	2 (11%)
No. of patients with HIV cared for/week	
0-5 patients	2 (11%)
6-10 patients	5 (26%)
11-20 patients	4 (21%)
21-50 patients	2 (11%)
>50 patients	6 (32%)
Time caring for TB patients/week	
0-1 day	0 (0%)
1-2 days	2 (11%)
2-3 days	4 (21%)
3-4 days	6 (32%)
4-5 days	7 (37%)
No. of patients with TB cared for/week	
0-5 patients	5 (26%)
6-10 patients	9 (47%)
11-15 patients	0 (0%)
15-20 patients	4 (21%)
>20 patients	1 (5%)

assess knowledge of the use of ultrasound in the FASH exam before and after the training course (see Appendices 1 and 2). Quizzes were completed before and after training by all 19 participants. Quiz results were reported as a percentage score. McNemar's Test was used to evaluate the significance of the percentage change in pre- and post-training quiz scores.

After completing the training course, participants were also surveyed on: whether they would incorporate the FASH exam into their clinical practice; the most challenging part of the FASH exam; the number of FASH exams they needed to complete before feeling comfortable using it in their clinical practice; whether the FASH exam would improve their ability to diagnose TB; and whether the FASH exam would improve their patient care.

Three new ultrasound machines (ClearVue 650, Philips, Amsterdam, Netherlands) were purchased for the study and used during the four training weeks. A C5-2 abdominal probe (2-5MHz) was used for the FASH study, and an S4-1 cardiac probe (1-4 MHz) was used for cardiac imaging. After completion of the training courses, the ultrasound machines were set up at each of the three sites for clinical use and collection of ongoing research data.

Informed consent for this study was signed by all participants prior to the start of training. The study protocol was approved by the Malawi National Health Sciences Research Committee and the Institutional Review Board (IRB) at UCLA.

Results

Nineteen individuals were eligible for inclusion in the study and underwent training. All participants completed both the pre- and post-training surveys. Demographics data is presented in Table 1. The trainees consisted of physicians (n=5), clinical officers (n=9), radiology technicians (n=4), and a medical assistant (n=1). Clinicians had an average of 8.4 years of clinical experience, an average of 6.9 years of experience treating HIV patients, and an average of 7.5 years of experience treating TB patients. The majority (n=13, 68%) reported spending more than three days per week involved in the care of patients with HIV and TB. Most clinicians had prior experience with ultrasound, with the majority (n=15, 79%) having used it for the management of obstetric patients. Twenty-one percent (n=4) of the clinicians had prior experience using ultrasound to assist with TB diagnosis and 11% (n=2) of the clinicians had used the FASH protocol prior to the training course.

Results on clinicians' comfort level in diagnosing pulmonary and extrapulmonary TB are presented in Table 2. Thirty-seven percent (n=7) of respondents reported they were very comfortable diagnosing pulmonary TB before the training versus 53 percent (n=10) after the training. Eleven percent (n=2) of respondents were very comfortable diagnosing extrapulmonary TB before the training versus 53 percent (n=10) after the training. Lastly, 21% (n=4) of the respondents were somewhat comfortable or very comfortable using ultrasound to diagnose TB before the training versus 84% (n=16) after the training.

Table 2. Comfort level diagnosing pulmonary and extrapulmonary TB.

	Pre-Training	Post-Training
	n (%)	n(%)
Comfort Diagnosing Pulmonary TB		
Very Uncomfortable	3 (15.79%)	3 (15.79%)
Somewhat Uncomfortable	1 (5.26%)	0 (0.00%)
Neutral	2 (10.53%)	0 (0.00%)
Somewhat Comfortable	6 (31.58%)	6 (31.58%)
Very Comfortable	7 (36.74%)	10 (52.63%)
Comfort Diagnosing Extrapulmonary TB		
Very Uncomfortable	2 (10.53%)	3 (15.79%)
Somewhat Uncomfortable	3 (15.79%)	0 (0.00%)
Neutral	3 (15.79%)	0 (0.00%)
Somewhat Comfortable	9 (47.37%)	6 (31.58%)
Very Comfortable	2 (10.53%)	10 (52.63%)

Participants' knowledge of the FASH technique significantly improved after the four-day course, with a 32% increase in total quiz questions answered correctly (45% pre-course quiz versus 77% post-course quiz, $p<0.001$).

After completing the training course, the evaluation questions were tabulated. Table 3 summarizes data from the participants' evaluations of the training course. All participants were queried regarding the utility of the FASH exam. Ninety-five percent (n=18) of participants answered that they would "likely" incorporate FASH in their clinical practice, with the other 5% (n=1) answering that they were "somewhat likely." Approximately 90% (n=17) of the participants felt that they needed 10 FASH exams or fewer to feel comfortable implementing ultrasound to diagnose TB. Furthermore, 100% (n=19) of participants agreed that the FASH exam would

Table 3. Post-training course evaluation.

How likely are you to incorporate FASH in clinical practice?		
Percent (%)	Freq. (n)	
0.00%	0	Unlikely
0.00%	0	Somewhat Unlikely
0.00%	0	Neutral
5.26%	1	Somewhat Likely
94.74%	18	Likely
100	19	Total
Most challenging part of FASH?		
Percent (%)	Freq. (n)	
5.26%	1	Pericardial Effusion
21.05%	4	Pleural Effusion
15.79%	3	Abdominal Lymph Nodes
57.89%	11	Splenic/Hepatic Microabscesses
100%	19	Total
Number of FASH exams before feeling comfortable using ultrasound for TB		
Percent (%)	Freq. (n)	
52.63%	10	0-5
36.84%	7	6-10
5.26%	1	11-20
5.26%	1	>30
100%	19	Total
Do you agree that FASH will improve your ability to diagnose TB?		
Percent (%)	Freq. (n)	
0.00%	0	Disagree
100%	19	Agree
100%	19	Total
Do you agree that FASH will improve the patient care in your clinic?		
Percent (%)	Freq. (n)	
0.00%	0	Disagree
94.74%	18	Agree
5.26%	1	Did not answer
100%	19	Total

improve their ability to diagnose TB and 95% (n=18) agreed that FASH would improve patient care in their clinic.

Discussion

Our study found that after completing a four-day training course, medical providers were more knowledgeable about the FASH exam and its findings and felt more comfortable using ultrasound for the diagnosis of TB. Participants were also unanimous in the opinion, after completing the training, that the FASH ultrasound exam would improve their ability to diagnose TB.

Despite the high prevalence of TB in HIV-infected patients, clinicians in resource-limited settings are faced with numerous challenges in establishing a diagnosis, particularly for extrapulmonary TB. Ultrasound is safe, inexpensive, and has the potential to increase the diagnostic yield of TB in this setting. However, ultrasound is an operator-dependent imaging modality, and the utility and applicability of ultrasound depends on the skill of the provider, which in turn depends on adequate training and supervision on the use of ultrasound. The WHO Scientific Group on clinical diagnostic imaging concluded that "more important than the equipment is the availability of skills" (16). There are no established guidelines regarding duration or content of training courses for focused ultrasound examinations in low- and middle-income countries, and previously published examples of training activities have ranged from two days to nine weeks (6,13).

Heller et al. developed the FASH protocol for the rapid assessment of common extrapulmonary TB findings and used a two-day training protocol to teach it to three junior physicians with no prior ultrasound experience. After this training, the physicians had very good sensitivity and specificity when compared to the reference examiner (13). Much of medical care in resource-limited settings is provided by non-physician medical providers such as clinical officers. Our study expands on the experience of Heller, demonstrating that after completing a short, four-day training course, medical providers of varied backgrounds, including medical assistants, radiology technicians, clinical officers and physicians, were more knowledgeable about the FASH exam and felt more comfortable using ultrasound to aid in the diagnosis of TB. To our knowledge, we present the first published results of training non-physician ultrasonographers in the FASH exam.

In our study, the clinicians reported hepatic and splenic focal lesions were more difficult to recognize, which is consistent with the results previously described by Heller et al., in which trainees had lower confidence in the FASH-plus findings (abdominal lymph nodes, hepatic and splenic focal lesions) compared to

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identifying free fluid (13). Ongoing research at these clinical sites is being performed and will include evaluation of trainees' FASH exams by an expert sonographer, overreading and providing quality feedback to ensure retention of the training and accuracy of the image acquisition and interpretation. This ongoing research will provide a means for continued mentoring and quality assurance. These results will be published separately as data are acquired and will be important in fully evaluating the educational impact of our four-day training course. In addition, clinical outcomes data based on the accuracy of diagnosis of HIV/TB using FASH, immunologic and microbiologic diagnostic exams will be published separately as the data are acquired.

We propose that future courses on the FASH protocol taught to paramedical staff with variable backgrounds in training be at least four days in duration. This allows the trainees to build upon their knowledge of anatomy, physiology, and disease processes throughout the course and ask questions during the frequent hands-on training sessions. Having multiple hands-on training sessions in a four-day period also allows the trainee to improve their scanning technique. We also encourage future course directors to provide printed and electronic teaching materials for the trainees to review prior to the course. Teaching the FASH technique to providers in resource-poor countries may improve their ability to diagnose extra-pulmonary TB, and has the added benefit of introducing ultrasound and its many point-of-care diagnostic capabilities.

Conclusion

Ultrasound has been shown to be an inexpensive and valuable diagnostic imaging tool, especially in low- and middle-income countries, but is operator-dependent and relies on the availability of appropriate skills and training. Participants who completed our course had a wide range of clinical experience and training backgrounds, but improved in both their confidence and knowledge of ultrasound as a diagnostic tool. Ongoing and future follow-up studies are needed to evaluate how clinicians perform in FASH after training, and the degree of expert support needed, if any.

Conflict of interest

The authors report no conflict of interest.

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Appendix 1. Provider Baseline Pre-Test Survey: Evaluation of provider-level experience diagnosing tuberculosis and using ultrasound in patients with HIV infection in Malawi.

Instructions:
1. Fill out the form using a pen
2. For yes/no answers tick the box appropriately
3. Please enter the best answer or circle the one best answer for each question below

Date of Survey: _____ / _____ / _____
dd / mm / yy

#	**DEMOGRAPHICS AND SELF RATED COMFORT LEVEL** Please enter the best answer or circle the one best answer for each question below:	
1	How old are you?	_____ Years
2	Gender	Male (1) Female (2)
3	Type of Health Care Worker:	Clinical Officer (1) Doctor (2) Other (specify): _____ (3)
4	Clinical site	_____(name)
5	How many years after training have you been working as a clinician? Please round to the nearest year.	_____ Years
6	What amount of time do you spend taking care of HIV patients per week?	1 or fewer days ☐ (1) More than 1, up to 2 days ☐ (2) More than 2, up to 3 days ☐ (3) More than 3 up to 4 days ☐ (4) More than 4 up to 5 days ☐ (5)
7	How many patients with HIV do you take care of in a week? Best estimate	0-5 ☐ (1) 6-10 ☐ (2) 11-20 ☐ (3) 21-50 ☐ (4) >50 ☐ (5)
8	How many years of experience do you have in treating HIV patients? Please round to the nearest year.	_____ Years
9	What amount of time do you spend taking care of TB patients or TB suspect patients per week?	1 or fewer days ☐ 1 More than 1, up to 2 days ☐ 2 More than 2, up to 3 days ☐ 3 More than 3 up to 4 days ☐ 4 More than 4 up to 5 days ☐ 5

10	How many patients with TB do you take care of in a week?	0-5 ☐ 1 6-10 ☐ 2 11-15 ☐ 3 16-20 ☐ 4 >20 ☐ 5
11	How many years of experience do you have in treating TB patients? Please round to the nearest year.	_____ years
12	How comfortable are you diagnosing patients with pulmonary TB?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
13	How comfortable are you diagnosing patients with extrapulmonary TB?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
14	Have you used ultrasound to diagnose tuberculosis?	Yes ☐ 1 No ☐ 0
15	Have you used ultrasound to treat obstetric patient?	Yes ☐ 1 No ☐ 0
16	Have you use ultrasound to assess or treat abscess?	Yes ☐ 1 No ☐ 0
17	How comfortable are you to use ultrasound for medical care?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
18	How comfortable are you at using ultrasound to diagnose tuberculosis?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
19	Have you used the FASH protocol to diagnose tuberculosis?	Yes ☐ 1 No ☐ 0
KNOWLEDGE QUESTIONS		
20	When the probe is placed transverse in the epigastric angle (just below the breast plate/sternum) and angled cranially, what pathologic finding may be visualized in a patient with extra-pulmonary TB?	a. Fluid in morrison's pouch b. Pericardial effusion c. Free fluid in the pelvis d. Hypoechoic lesions in the spleen
21	When trying to assess for pleural effusion by placing the transducer in the caudal part of the thorax, dorsal to the right mid-axillary line, how should you position the transducer?	a. Parallel to the ribs with the probe positioned on top of a rib b. Anti-parallel to the ribs c. Parallel to the ribs with the probe positioned in a transcostal view
22	When the positioning the probe to visualize the liver, you notice multiple hypoechioc liver lesions that are not ducts or vessels. In the setting of extra-pulmonary TB, these liver lesions likely represent which of the following?	a. Fluid within the liver b. Hepatic abscesses c. Multiple liver infarcts d. Regenerative nodules
23	Simple free fluid within the abdomen, without associated blood or pus, will be which of the following echogenicities?	a. Hypoechoic b. Hyperechoic c. Anechoic d. Hypoechoic with mobile echogenic structures e. Echogenic

24	Which of the following best described pathologic lymph nodes in the setting of HIV infected individuals?	a. 1 cm lymph node with fatty hilum b. hyperechoic lymph node measuring 1 cm in the longest axis c. 3 cm, hypoechoic, lymph node with replaced fatty hilum d. 0.5 cm, kidney bean shaped lymph node with a fatty hilum and flow in the center
25	The following finding is not part of the FASH exam	a. Ascites b. Pericardial effusion c. Enlarged abdominal lymph nodes d. Mediastinal Lymphadenopathy e. Hypoechoic splenic lesions

Appendix 2. Provider Follow-Up Post-Test Survey: Evaluation of provider-level experience diagnosing tuberculosis and using ultrasound in patients with HIV infection in Malawi .

Instructions:
1. Fill out the form using a pen
2. For yes/no answers tick the box appropriately
3. Please enter the best answer or circle the one best answer for each question below

Date of Survey: _____ / _____ / _____
dd / mm / yy

#	**SELF RATED COMFORT LEVEL** **Please enter the best answer or circle the one best answer for each question below:**	
1	How comfortable are you diagnosing patients with pulmonary TB?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
2	How comfortable are you diagnosing patients with extrapulmonary TB?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
3	How comfortable are you to use ultrasound for medical care?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
4	How comfortable are you at using ultrasound to diagnose tuberculosis?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
5	How comfortable are you to use the FASH protocol now to diagnose tuberculosis?	Very Uncomfortable ☐ 1 Somewhat Uncomfortable ☐ 2 Neutral ☐ 3 Somewhat Comfortable ☐ 4 Very Comfortable ☐ 5
KNOWLEDGE QUESTIONS		
6	When the probe is placed transverse in the epigastric angle (just below the breast plate/sternum) and angled cranially, what pathologic finding may be visualized in a patient with extra-pulmonary TB?	a. Fluid in morrison's pouch b. Pericardial effusion c. Free fluid in the pelvis d. Hypoechoic lesions in the spleen

7	When trying to assess for pleural effusion by placing the transducer in the caudal part of the thorax, dorsal to the right mid-axillary line, how should you position the transducer?	a. Parallel to the ribs with the probe positioned on top of a rib b. Anti-parallel to the ribs c. Parallel to the ribs with the probe positioned in a transcostal view
8	When the positioning the probe to visualize the liver, you notice multiple hypoechioc liver lesions that are not ducts or vessels. In the setting of extra-pulmonary TB, these liver lesions likely represent which of the following?	a. Fluid within the liver b. Hepatic abscesses c. Multiple liver infarcts d. Regenerative nodules
9	Simple free fluid within the abdomen, without associated blood or pus, will be which of the following echogenicities?	a. Hypoechoic b. Hyperechoic c. Anechoic d. Hypoechoic with mobile echogenic structures e. Echogenic
10	Which of the following best described pathologic lymph nodes in the setting of HIV infected individuals?	a. 1 cm lymph node with fatty hilum b. Hyperechoic lymph node measuring 1 cm in the longest axis c. 3 cm, hypoechoic, lymph node with replaced fatty hilum d. 0.5 cm, kidney bean shaped lymph node with a fatty hilum and flow in the center
11	The following finding is not part of the FASH exam	a. Ascites b. Pericardial effusion c. Enlarged abdominal lymph nodes d. Mediastinal Lymphadenopathy e. Hypoechoic splenic lesions

EVALUATION QUESTIONS		
12	How likely are you to incorporate the FASH exam into your clinical practice outside of a study like this one?	Unlikely ☐ 1 Somewhat Unlikely ☐ 2 Neutral ☐ 3 Somewhat Likely ☐ 4 Likely ☐ 5
13	What part of the FASH exam do you find most challenging?	Pericardial effusion ☐ 1 Pleural Effusion ☐ 2 Ascites ☐ 3 Abdominal Lymph Nodes ☐ 4 Splenic/Hepatic microabscesses ☐ 5
14	How many FASH exams did you perform before feeling comfortable using ultrasound for TB diagnosis?	0-5 ☐ 1 6-10 ☐ 2 11-20 ☐ 3 21-30 ☐ 4 >30 ☐ 5
15	The FASH exam will improve my ability to diagnose TB.	Agree ☐ 1 Disagree ☐ 0
16	The FASH exam will improve patient care for individuals in my clinic.	Agree ☐ 1 Disagree ☐ 0