Impact of mycobacterial culture among HIV-infected adults with presumed TB in Uganda: a prospective cohort study

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Background: Implementation of new tuberculosis (TB) diagnostic strategies in resource-constrained settings is challenging. We measured the impact of solid and liquid mycobacterial cultures on treatment practices for patients undergoing TB evaluation in Kampala, Uganda.

Methods: We enrolled consecutive smear-negative, human immunodeficiency virus positive adults with cough of ≥ 2 weeks from September 2009 to April 2010. Laboratory technicians performed mycobacterial cultures on solid and liquid media. We compared empiric treatment decisions with solid and liquid culture in terms of diagnostic yield and time to results, and assessed impact on patient management.

Results: Of 200 patients enrolled, 26 (13%) had culture-confirmed TB: 22 (85%) on solid culture alone, 2 (8%) on liquid culture alone, and 2 (8%) on both solid and liquid culture. Thirty-four patients received empiric anti-tuberculosis treatment, but only 10 (29%) were culture-positive. Median time to a positive result on solid culture was 92 days (interquartile range [IQR] 69–148) compared to 106 days (IQR 66–157) for liquid culture. No patients initiated treatment following a positive result on liquid culture.

Conclusion: The introduction of mycobacterial culture did not influence care for patients undergoing evaluation for TB in Kampala, Uganda. Attention to contextual factors surrounding implementation is needed to ensure the effective introduction of new testing strategies in low-income countries.

Slow, nonsensitive diagnostic testing for tuberculosis (TB) contributes to high morbidity and mortality among human immunodeficiency virus (HIV) infected patients worldwide.^{1,2} A more rapid and sensitive test could enhance early detection of TB and improve patient outcomes, especially in low-income countries. Such tests could also facilitate early exclusion of TB and allow the initiation of preventive therapy among HIV-infected patients.^{3–5} Liquid culture using the Mycobacteria Growth Indicator Tube (MGIT™) system (BD, Franklin Lakes, NJ, USA) has the potential to address these needs.^{6,7} Its advantages include its high sensitivity and specificity, as well as low cost when procured at preferential prices available to the public sector.⁸ However, it is labor-intensive and requires significant microbiologic expertise and specialized laboratories to ensure biosafety.

The Uganda National Tuberculosis and Leprosy Program (NTLP) introduced liquid culture at the National

Tuberculosis Reference Laboratory (NTRL) in 2009, in preparation for scaling up the technique to other laboratories throughout Uganda. The NTLP received no outside support in the form of financing, training, or infrastructure development to facilitate the implementation of liquid culture. To assess the value of culture in routine settings, we designed a prospective longitudinal cohort study to examine the accuracy and impact of MGIT and solid culture, compared to standard clinical management in smear-negative HIV-infected out-patients in Uganda.

METHODS

Participants

From September 2009 to April 2010, we prospectively screened consecutive HIV-infected adults (≥ 18 years) with cough of ≥ 2 weeks at the Mulago Immune Suppressive Syndrome (ISS) Clinic in Kampala, Uganda. We excluded patients who were already taking anti-tuberculosis treatment, resided >30 km from the clinic, or were unable to expectorate sputum spontaneously. We invited all patients who were acid-fast bacilli (AFB) smear-negative on initial sputum examination to enroll.

Procedures

We collected demographic and clinical information using a standardized questionnaire. We confirmed HIV test results and recorded the most recent CD4+ T-lymphocyte count from medical records. We collected two additional expectorated sputum samples on the second day. We sent the first, early morning, specimen for direct fluorescence microscopy. To prevent patients from having to wait for a second negative smear result to provide sputum for culture, we collected the second, spot, specimen and sent it simultaneously to the NTRL for solid and liquid culture. Patients with negative initial smear results were treated with broad-spectrum antibiotics; those who remained symptomatic and undiagnosed after 2 weeks were initiated on empiric anti-tuberculosis treatment.

The second sputum sample was delivered to the NTRL on the day of collection. After *N*-acetyl-L-cysteine-sodium hydroxide (NALC-NaOH) concentration (incubation with 0.5% NALC, 2% NaOH and 1.5% sodium citrate, and centrifugation at 3000 $\times$ g), the sediment was inoculated onto solid Löwenstein-Jensen (LJ) and liquid (MGIT) media. After adding bovine serum albumin (50 g) and the antibiotic supplement polymyxin B 6000 units, amphotericin B 600 μ g, nalidixic acid 2400 μ g, trimethoprim 600 μ g and azlocil-

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lin 600 µg (PANTA), laboratory staff incubated liquid cultures in the automated BACTEC MGIT 960 mycobacterial culture detection system, screened positive liquid cultures for AFB using Kinyoun staining, and performed mycobacterial speciation on Kinyoun-positive isolates. Protocols specified the Capilia TB assay (TAUNS, Numazu, Japan) to identify *Mycobacterium tuberculosis* and the GenoType® MTBC test (Hain Life-science, Nehren, Germany) to speciate non-tuberculous mycobacteria (NTM) if the isolate was Capilia-negative. Kinyoun-negative isolates were cultured on sheep's blood agar to identify overgrowth by bacteria other than mycobacteria. Solid cultures were incubated at 37°C and inspected weekly for growth, with speciation by visual inspection.⁹

Liquid cultures were reported as negative 42 days after inoculation and solid cultures 56 days after inoculation. NTRL staff provided written reports for all final culture results. The clinic's infection control nurse was responsible for collecting results daily and recording them in clinic records. She attempted to reach patients by telephone to provide results and follow-up instructions within one day.

We reviewed clinic records 6 and 12 months after enrollment to record vital status and determine whether clinicians had used the culture results to adjust their treatment plans.

Analysis

We examined the proportion of patients lost to follow-up at each evaluation step. We performed bivariate analyses comparing clinical characteristics with final TB status, defined by a positive *M. tuberculosis* result on either solid or liquid culture. We compared categorical variables using the χ^2 or Fisher's exact test, and non-normally distributed continuous variables using the Mann-Whitney rank-sum test. We measured the incremental yields of empiric treatment and culture over smear examination, defined as the number of additional correctly classified cases among patients with and without TB. We calculated time to culture results, the proportion of patients with treatments changed following receipt of culture results, and 6- and 12-month mortality. All analyses were performed using Stata 11.0 (Stata Corporation, College Station, TX, USA).

Ethics

The University of California, San Francisco Committee on Human Research, the Makerere University Faculty of Medicine Research Ethics Committee and the Uganda National Council for Science and Technology approved the study protocol. All patients provided written informed consent.

RESULTS

Of 352 HIV-infected patients with cough of ≥ 2 weeks, we enrolled 200 with one negative initial smear. Of the 152 excluded patients, 24 (16%) were AFB-positive on the first smear, 15 (10%) had sputum examined but were inadvertently not invited to enroll, and 113 (74%) smear-negative patients failed to return to the

FIGURE Study enrollment flow diagram. HIV = human immunodeficiency virus; AFB = acid-fast bacilli; FM = fluorescence microscopy; MGIT = liquid Mycobacteria Growth Indicator Tube media; LJ = solid Löwenstein-Jensen media.

clinic within 7 days (Figure). Five of the 200 patients (2.5%) with a negative initial smear result tested smear-positive on the second specimen.

Of those enrolled, 128 (64%) were women (Table 1). Median age was 36 years (interquartile range [IQR] 30–43). Median CD4⁺ T-cell count was 266 cells/µl (IQR 135–399), and 102 (51%) were receiving antiretroviral therapy (ART). Thirty-eight (19%) had previously been treated for TB. Eighty-six (43%) reported fevers, chills, or night sweats, and 32 (16%) reported weight loss ≥ 5 kg. During the study period, 34 (17%) patients received empiric anti-tuberculosis treatment. Median time from enrollment to initiation of empiric anti-tuberculosis treatment was 15 days (IQR 11–30).

Culture results

One hundred and ninety-one (96%) patients were smear-negative on the early morning sputum specimen. Culture of the spot specimen identified 26 (13%) patients with culture-confirmed TB, 21 (11%) of whom were AFB-smear negative, and 126 (63%) who were negative on both solid and liquid media (Table 2). Of the patients with confirmed TB, 22 (85%) were positive on solid media only, two (8%) were positive on liquid media only and two (8%) were positive on both solid and liquid media. One patient whose specimen did not undergo liquid culture and 12 with NTM on liquid culture had *M. tuberculosis* on solid culture. Among the remaining 48 patients, it was learned upon requesting final results for 26 patients that no liquid culture had been performed. Of these, 24 had negative results on solid culture and two had contaminated solid cultures. Of the remaining patients, four had

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TABLE 1 Demographic and clinical characteristics of enrolled patients

Characteristic (<i>n</i> = 200)	<i>n</i> (%)
Women	128 (64)
Age, median [IQR]	36 [30–43]
CD4 count, median [IQR]	266 [135–399]
Taking ART at enrollment	102 (51)
Previous TB diagnosis	38 (19)
Fever, chills, night sweats	86 (43)
Weight loss ≥ 5 kg*	32 (16)
Cough duration, weeks, median [IQR]	3 [2–6]
Empirically treated for TB	34 (17)
Positive on solid culture†	24 (12)
Positive on liquid culture‡	28 (14)
<i>M. tuberculosis</i>	4 (14)
NTM	18 (64)
Indeterminate or missing <i>M. tuberculosis</i> speciation result	6 (21)

*87 missing.

†13 contaminated.

‡30 missing; 3 contaminated.

IQR = interquartile range; ART = antiretroviral therapy; TB = tuberculosis;

NTM = non-tuberculous mycobacteria.

contaminated liquid cultures (all were negative on solid culture) and six had NTM on liquid culture, of whom four (2%) had negative solid cultures and two (1%) had contaminated solid cultures. Six patients, three with negative results on solid media and three with positive results on solid media, were positive on liquid culture with species that could not be identified. In total, 50/352 (14%) patients with cough ≥ 2 weeks had microbiologically confirmed TB — 29 smear-positive and 21 smear-negative patients.

The added value of solid culture for case detection and reducing overtreatment was substantial (Table 3), while liquid culture showed no significant added diagnostic value. The median time to a positive result on solid culture among the 24 culture-positive patients was 92 days (IQR 69–148), while that on liquid culture among the four *M. tuberculosis*-positives was 106 days (IQR 66–157). The median time to a negative result on solid culture was 121 days (IQR 73–165) compared to 109 days (IQR 72–146) on liquid culture.

Treatment decisions and patient outcomes

Of the 26 patients with TB, 10 (38%) received empiric treatment and six (23%) initiated anti-tuberculosis treatment following a positive result on solid media. The remaining 10 (38%) did not initiate treatment. No patients initiated treatment following a positive result on liquid culture in the absence of a positive solid culture. The median time to treatment initiation following a positive result on solid culture was 31 days (IQR 6–69), while that

from enrollment to treatment initiation in smear-negative patients identified by culture alone was 42 days (IQR 4–83).

Of the 34 patients who received empiric anti-tuberculosis treatment, 10 (29%) had positive cultures on solid or liquid media. Of the 24 empirically treated patients who had negative cultures, three (13%) continued anti-tuberculosis treatment and were alive at the end of the 12-month follow-up period. Twenty additional empirically treated patients with negative cultures stopped treatment and were alive at the 12-month follow-up. One empirically treated patient with a negative culture died. The median time to stopping treatment for patients with a negative solid culture result was 176 days (IQR 166–186), suggesting that most empirically treated patients would have completed a full course of treatment before results were available. The median time to treatment discontinuation following a negative result on liquid media was 177 days (IQR 166–190).

Of 200 patients enrolled, 193 completed the 12-month follow-up visit; five patients were seen once during follow-up, but could not be contacted thereafter; two additional patients died during follow-up without a post-mortem report.

Implementation problems and solutions identified

Research staff identified several solutions to make the MGIT procedures run more smoothly and to better integrate them with other laboratory activities (Table 4). First, there were several barriers to the flow of specimens through the laboratory, including non-adherence to protocols for sample transfers and a failure of technicians to coordinate activities. These factors were associated with delayed inoculation of liquid cultures. Second, several challenges affected performance, including staff assignments, coordinating duties and hand-off of responsibilities. Third, there were technical problems in implementing liquid culture, including incomplete installation of MGIT 960 software, errors during routine servicing of MGIT machines, and stock-outs of speciation assays, leading to delayed reporting of liquid culture results. Finally, there was no automated system for tracking samples. After addressing these barriers and installing a computerized laboratory information management system, the turnaround time for liquid cultures fell and the number of positive results increased, albeit in other populations, as the Mulago-ISS Clinic discontinued using these services.

DISCUSSION

As more rapid and accurate TB diagnostic tools become available, it is increasingly important to link these assays to efficient specimen collection, delivery, and results reporting to facilitate timely clinical decision making and realize clinical gains. In this implementation research study evaluating the impact of liquid culture

TABLE 2 Comparison of results of mycobacterial culture on solid and liquid media with rapid speciation

Results of solid culture	Results of liquid culture, <i>n</i>						Total
	Negative	<i>M. tuberculosis</i>	NTM	Contaminated	Positive, indeterminate or missing species	Missing	
Negative	126	2	4	4	3	24	163
Positive*	6	2	12	0	3	1	24
Contaminated	9	0	2	0	0	2	13
Total	141	4	18	4	6	27	200

*All positive cultures on solid media visually speciated as *M. tuberculosis*.⁹

NTM = non-tuberculous mycobacteria.

TABLE 3 Diagnostic accuracy and incremental diagnostic value of different components of the TB evaluation algorithm

Test (<i>n</i> = 26)	Yield of true positives % (95%CI)	Incremental yield of true positives* % (95%CI)	Days to result median [IQR]
A) Microbiologically confirmed TB patients			
Sputum smear microscopy			
Sputum 1 (spot) positive	0 (0) (0–13)	–	–
Sputum 2 (morning) positive	5 (19) (7–39)	+19 (+0.2 to +38)	–
Empiric decision to treat for TB	10 (38) (20–59)	+19 (–3 to +42)	18 [4–42]
Liquid culture (MGIT) positive	4 (15) (4–35)	–23 (–38 to +8)	106 [66–157]
Solid culture (LJ) positive	24 (92) (75–99)	+77 (+51 to +85)	92 [69–148]
Test (<i>n</i> = 174)	Yield of true negatives % (95%CI)	Incremental yield of true negatives† % (95%CI)	Days to result median [IQR]
B) Microbiologically confirmed non-TB patients			
Sputum smear microscopy			
Sputum 1 (spot) positive	174 (100) (98–100)	–	–
Sputum 2 (morning) positive	170 (98) (94–99)	–2% (–5 to +1)	–
Empiric decision to treat for TB	150 (86) (80–91)	–11% (–17 to +6)	15 [11–30]
Liquid culture (MGIT) positive	174 (100) (98–100)	+13% (+8 to +14)	109 [72–146]
Solid culture (LJ) positive	174 (100) (96–100)	+0% (–1 to +1)	121 [73–165]

Note: Contaminated solid and missing/contaminated liquid culture results were coded as negative for the purposes of illustrating their incremental diagnostic value (see Table 2).

*Defined as the number of TB patients additionally identified as TB patients compared to the previously available index test shown in the row immediately above. A negative value indicates that a higher proportion of these additional patients are incorrectly diagnosed as not having TB compared to the previously available test.

†Defined as the difference in proportion of non-TB patients additionally identified as non-TB patients compared to the previously available index test shown in the row immediately above. A negative proportion indicates that a higher proportion of these additional patients are incorrectly diagnosed as having TB compared to the previously available index test.

TB = tuberculosis; IQR = interquartile range; LJ = Löwenstein-Jensen; MGIT = Mycobacteria Growth Indicator Tube. CI = confidence interval.

on the management and outcomes of HIV-infected adults with cough of ≥ 2 weeks when performed routinely in a high HIV and TB burden setting, we found that liquid culture provided no incremental benefit over solid culture; that the turnaround time was prolonged for both culture methods due to laboratory delays in inoculating the cultures and delays in the clinic in requesting results; and, most importantly, that the tests did not alter patient management. Nevertheless, through these dramatic implementation failures, the laboratory staff identified key areas for improvement, including reorganizing and consolidating staff responsibilities, streamlining and tracking specimen flow with the help of computerized reminders, and acquiring technical expertise through repeated failures. These insights led to dramatic improvements in liquid culture services in the post-implementation period, with the laboratory ultimately obtaining Supra-National Reference Laboratory status in 2013.

There were a number of other significant findings. First, we found a high prevalence of TB among HIV-infected patients with cough of ≥ 2 weeks (at least 14% of all eligible patients and 11% of confirmed smear-negative patients). Second, NTM were isolated in 9% of all cultures, two thirds of which grew *M. tuberculosis* on solid culture. Although final speciation using the GenoType MTBC test was requested, it was unfortunately not performed, which prevented us from determining whether the high rates of NTM are due to pathogens or commensals. Third, the majority of patients empirically initiated on anti-tuberculosis treatment had negative cultures on both solid and liquid media, and none of the patients who started anti-tuberculosis treatment did so solely based on a positive liquid culture. This demonstrates that empiric anti-tuberculosis treatment is common and performs poorly even in the set-

ting of a well-resourced ART clinic with experienced clinicians.¹⁰ Nevertheless, as is widely reported elsewhere,¹¹ TB is also likely underdiagnosed, even though our study failed to identify any adverse outcomes, perhaps because of the 97% rate at one-year follow-up.

Similar results have been observed in other low-income countries. A study in South Sudan showed that although it identified a significant number of additional TB cases, liquid culture was associated with unnecessarily long delays and provided fewer clinical benefits than expected.¹² In a study from Southern India, Stall et al. found that empiric treatment preceded positive culture results in 83% of cases, and that 77% of patients with negative cultures continued anti-tuberculosis treatment.¹³ Experienced laboratories in high-income countries have highlighted the perils of cross-contamination and contamination by NTM,¹³ which we identified as an important potential problem. Nevertheless, after our study ended, a quality improvement initiative reduced the turnaround time from receiving the sample to reporting positive results back to our clinic to approximately 2 weeks for MGIT culture and about 3.5 weeks for LJ culture. These results are comparable to those reported in other settings,¹⁴ suggesting that new technologies can be successfully introduced in resource-constrained settings provided they are accompanied by adequate staffing, training, and external quality assurance programs.

Importantly, one third of patients failed to return to the clinic within one week of providing the initial sputum specimen. This highlights the importance of same-day testing, reporting, and treatment initiation. Provision of a point-of-care TB test that provides results before a patient leaves the clinic may be more effective than culture, as all patients would then complete the evaluation in one visit, without the need for return visits for additional

TABLE 4 Problems identified and explanations and solutions implemented

Problem	Explanation	Solution
Workflow and documenting results		
Delays in MGIT inoculation	Lack of standardized specimen workflow, responsibility, or deadlines for processing and inoculation, with tasks assigned to multiple individuals	Reorganization of workflow to assign solid and liquid culture inoculation to a single technician with defined timelines for work completion
Delays in reporting MGIT results	Failure to check MGIT machine daily for results, with reporting log organized by inoculation date rather than by result date	Reorganization of results log by result date, with documented daily checks verified by laboratory manager; introduction of a computerized laboratory information management system
Delays in speciation of positive cultures with tests not performed according to guidelines	Lack of staff familiarity with standard MGIT protocols	Distribution and discussion of standard MGIT protocols. Creation of flow charts illustrating positive culture speciation algorithm. Daily checks by supervisor for errors and completeness
Personnel		
Inadequate hand-off of samples to colleagues leading to lost cultures	Monthly rotations of NTRL staff through solid and liquid culture sections	Lengthening of rotations to every 6 months with laboratory supervisor auditing transfer of work responsibilities at the start of a new rotation
Conflicting responsibilities for staff	Assignment of staff members responsible for MGIT to perform off-site external quality assurance at peripheral laboratories outside Kampala	Changes in staff scheduling to ensure that at least one technician remains present in the solid culture and the liquid culture sections of the laboratory
Technical problems		
Error during servicing: machine indicated all tubes were positive	Failure to update MGIT 960 software on time	Training of staff to perform regularly scheduled software updates
MGIT machine results had to be manually linked to NTRL ID number	Incomplete installation of MGIT 960 software	Full installation of software and a laboratory information management system
Stock-outs of Capilia speciation tests	Insufficient supply chain management	Introduction of inventory system

MGIT = Mycobacteria Growth Indicator Tube; NTRL = National Tuberculosis Reference Laboratory; ID = identification.

testing,¹⁵ which often do not occur. For tests rapid enough to report results in time for same-day treatment initiation, the larger numbers of patients appropriately started on treatment instead of being lost to follow-up may outweigh the number of TB patients whose diagnoses are missed due to the use of a test that is less sensitive than culture.^{16,17} The costs, complexities, and delays of culture also highlight the need for rapid, specific triage tests, such as high sensitivity C-reactive protein assays,¹⁸ to minimize empiric over-treatment and reduce the need for rapid confirmatory testing with expensive molecular or culture-based assays.

In this study there were certain limitations. The study covered only the period immediately following the introduction of liquid culture, and therefore did not capture subsequent quality improvements. Future studies should document improvements and sustainability of new diagnostic strategies over time. Nevertheless, our study illustrates the challenges of implementing and scaling up liquid culture services in settings with high burdens of TB and HIV. Second, although the World Health Organization recommended chest radiography in contemporaneous TB-HIV evaluation guidelines,¹⁵ it was not routinely performed at that time because of its high cost. A number of studies have cited the imperfect sensitivity, low specificity, and high cost of chest radiography in high HIV prevalence areas,^{19–22} and we believe our study design likely reflects concurrent practice in Uganda and other similar settings. Finally, we performed only one liquid and one solid culture, potentially reducing the sensitivity for culture-negative TB. However, the low overall mortality rate suggests that clinicians were able to manage patients effectively without these results, likely due to the close clinical follow-up.

In conclusion, new TB diagnostic technologies are needed to catalyze clinical evaluation processes and improve patient care

in resource-constrained settings. Culture methods, with their heavy labor requirements and slow turnaround times, may not be suitable for this purpose. Adopting less sensitive but more specific same-day testing approaches, using molecular diagnostics such as GeneXpert® MTB/RIF (Cepheid, Sunnyvale, CA, USA), is likely to have a greater impact on patient outcomes. Attention to contextual factors surrounding implementation, including technical and logistical aspects, is needed to ensure effective introduction of new tests in resource-constrained settings.

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Contexte : La mise en œuvre de nouvelles stratégies de diagnostic de la tuberculose (TB) dans les contextes de ressources limitées constitue un défi. Nous avons mesuré l'impact des cultures mycobactériennes en milieu solide et liquide sur les pratiques de traitement des patients ayant une évaluation de la TB à Kampala, Ouganda.

Méthodes : Nous avons enrôlé des patients adultes consécutifs à frottis négatif, positifs pour le virus de l'immunodéficience humaine avec toux de ≥ 2 semaines, de septembre 2009 à avril 2010. Les techniciens de laboratoire ont réalisé des cultures mycobactériennes en milieu solide et liquide. Nous avons comparé les décisions de traitement empirique aux cultures en milieu solide et liquide en termes de rendement diagnostique et de délai d'obtention des résultats et nous avons évalué l'impact sur la gestion des patients.

Résultats : Des 200 patients enrôlés, 26 (13%) avaient une TB confirmée par culture, 22 (85%) par culture en milieu solide seule, 2

(8%) par culture en milieu liquide seul et 2 (8%) par culture à la fois en milieu solide et liquide. Trente-quatre patients ont reçu un traitement de TB empirique, mais seulement 10 (29%) ont eu une TB à culture positive. Le délai médian d'obtention d'un résultat de culture positive en milieu solide a été de 92 jours (IQR 69–148). Le délai médian d'obtention d'un résultat de culture positive en milieu liquide a été de 106 jours (IQR 66–157). Aucun patient n'a commencé un traitement à la suite d'un résultat de culture positive en milieu liquide.

Conclusion : L'introduction de la culture mycobactérienne n'a pas influencé les soins aux patients bénéficiant d'une évaluation de TB à Kampala, Ouganda. Il est nécessaire d'être attentif aux facteurs contextuels entourant la mise en œuvre afin d'assurer une introduction effective de nouvelles stratégies de tests dans les pays à faible revenu.

Marco de referencia: La ejecución de nuevas estrategias de diagnóstico de la tuberculosis (TB) en los entornos con limitación de recursos es problemática. En el presente estudio se midió la repercusión del uso del cultivo de micobacterias en medio sólido o líquido sobre las prácticas de tratamiento de los pacientes en curso de investigación diagnóstica de la TB en Kampala, Uganda.

Métodos: Se incluyeron de manera consecutiva en el estudio los pacientes adultos, seronegativos frente al virus de la inmunodeficiencia humana, que consultaban por tos de ≥ 2 semanas de duración y presentaban baciloscopia negativa, de septiembre del 2009 a abril del 2010. Los auxiliares de laboratorio practicaron el cultivo de micobacterias en medio sólido y medio líquido. Se compararon las decisiones empíricas de tratamiento y los tipos de cultivo, con respecto al rendimiento diagnóstico y al lapso hasta obtener los resultados y se evaluó su repercusión en el manejo de los pacientes.

Resultados: De los 200 pacientes que participaron en el estudio, 26 obtuvieron confirmación del diagnóstico de TB mediante el cultivo

(13%), 22 de ellos con el cultivo en medio sólido únicamente (85%), dos con el cultivo en medio líquido exclusivamente y dos con ambos tipos de cultivo (8%). Treinta y cuatro pacientes recibieron tratamiento antituberculoso empírico, pero solo 10 de ellos obtuvieron un cultivo positivo (29%). La mediana del lapso hasta obtener el resultado del cultivo en medio sólido fue 92 días (IQR 69–148). La mediana de este lapso con los cultivos en medio líquido fue 106 días (IQR 66–157). Ningún paciente inició el tratamiento antituberculoso después de haber obtenido el resultado positivo del cultivo en medio líquido.

Conclusión: La introducción del cultivo para micobacterias no tiene ninguna influencia en la atención que reciben los pacientes en quienes se investiga la TB en Kampala, Uganda. Es importante prestar atención a los factores contextuales que rodean la ejecución, a fin de lograr una introducción eficaz de las nuevas estrategias diagnósticas en los países con recursos limitados.