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ORIGINAL RESEARCH

Bacterial Profile, Susceptibility Patterns, and Factors Associated with Culture-Positive Sputum Among HIV Patients Presenting with a Cough in Northern Uganda

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Aim: Sub-Saharan Africa bears the highest burden of HIV/AIDS infections and constitutes 72% and 69% of AIDS-related deaths and people living with HIV worldwide, respectively. Due to the relationship between pulmonary infections and HIV/AIDS, it is biologically plausible that the surge in morbidity and mortality among HIV/AIDS patients could be attributed to an increase in pulmonary infections among this cohort of patients. This study determined the bacterial profile, susceptibility patterns, and factors associated with culture-positive sputum among HIV patients presenting with cough at the Lira Infectious Disease Centre in Northern Uganda.

Material and Methods: This prospective cross-sectional study recruited 180 participants. Culture and sensitivity of the sputum samples were done to determine the causative organism and its susceptibility. Blood agar, MacConkey's agar, and Chocolate agar were deployed for the culture media. Antimicrobial susceptibility testing was done using the Kirby-Bauer disc diffusion test. Data were analyzed using SPSS version 26.

Results: Out of the 180 enrolled patients, 113 were females with a mean age of 45. Bacterial growth was seen in 56 of the 180 samples. The most common isolate was *Staphylococcus aureus* at 35.7% of the 56 growths. The minority that accounted for 1.8% each were *Citrobacter freundii, Salmonella* species and *Acinetobacter baumanii,* respectively. A combination of ceftriaxone and gentamicin was effective against most organisms isolated in this study. At the multivariate level of analysis, an unsuppressed viral load and low peripheral oxygen saturation were independently associated with a sputum culture-positive cough.

Conclusion: HIV patients at LIDC who present with productive cough with low oxygen saturation and an unsuppressed viral load may be screened for *Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pneumonia, Klebsiella pneumonia*, and *Enterobacter* species infection. A combination of ceftriaxone and gentamicin may be used as empiric therapy before the culture and sensitivity results are available.

Keywords: HIV, susceptibility patterns, lira regional referral hospital, northern Uganda

Introduction

HIV affects and weakens the immune system of the human body, leaving it vulnerable to opportunistic diseases.[1] Opportunistic infections are still the leading cause of illness and death in HIV-positive people.[1] One of the most prevalent illnesses among people with HIV in Sub-Saharan African nations is lower respiratory tract infection (LRTI), which is a significant public health issue.[2] One of the most prevalent symptoms for which HIV patients seek medical attention is cough.[3] *Streptococcus pneumonia* is one of the most prevalent respiratory illnesses among people with HIV.[1] Even in the age of combination antiretroviral therapy (cART), respiratory tract infections are a substantial source

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of morbidity and mortality among HIV-positive patients.[4] In patients with HIV seropositivity, the infection rate varies from 3.9 to 20 infections per 100 people per year.[5] Bacterial, mycobacterial, fungal, viral, and parasitic infections are all included in the vast spectrum of HIV-associated opportunistic lower respiratory tract infections (LRTI). The prevalence of opportunistic infections such as LRTI continues to affect immunosuppressed people causing significant morbidity and mortality.[6] There is a paucity and inconsistency of data on the bacterial profile of LRTI in Uganda, more especially in Lira, northern Uganda. This study was conducted to determine the bacterial profile, susceptibility patterns and factors associated with culture-positive sputum among HIV patients presenting with cough at the Lira Infectious Disease Centre (LIDC).

Methodology

Study Design, Settings, Study Population

This was a prospective, cross-sectional study carried out at Lira Infectious Disease Center under Lira Regional Referral Hospital (LRRH), Northern Uganda. LRRH serves as a referral hospital for a population of approximately 2.5 million people in the districts of Amolatar, Apac, Lira, Oyam, Dokolo and Kole. The Lira Infectious Disease Centre is a unit within LRRH under internal medicine and the unit currently handles 12,000 clients on ART for HIV. The hospital also has a laboratory that can perform Gene-Xpert, microscopy, culture and sensitivity on sputum. The study recruited 180 consenting HIV-positive adults above the age of 18 years within 3 months using a consecutive sampling technique. Data were collected using a pre-tested semi-structured questionnaire.

The inclusion criteria comprised those who are confirmed to have HIV as per the patient's record, 18 years of age and above, those who could cough out sputum and who had given consent to participate. The exclusion criteria encompassed those with pulmonary tuberculosis, who could not cough out sputum and had taken antibiotics within the last 2 weeks including cotrimoxazole. Consent was obtained before sample collection. All 180 participants were given two sterile screw cap sputum containers; one for TB and the other for microscopy, culture and sensitivity. They were given clear instructions in the local language on how to collect the sputum sample. Participants who could not produce sputum on-site were allowed to take the containers home and collect the morning sputum. The containers were labelled with participants' study unique identification numbers. The samples were then transported within an hour in a biohazard bag to the microbiology laboratory at Lira Infectious Disease Center.

The samples were screened for TB using an automatic Gene-Xpert machine, those found negative for TB were then cultured on blood agar, Maconkey's agar and Chocolate agar for 18–24 hours. The bacterial morphology and arrangement were observed after Gram staining. Streptococcus and Staphylococcus species were differentiated using the Catalase test, while the Indole test was used to differentiate E. coli and Haemophilus influenza from Enterobacter species, Klebsiella species, Pseudomonas and Salmonella species. Simmon's citrate Agar was used to identify Enterobacteriaceae organisms. A urease test was performed to differentiate urease-positive organisms from those that are urease-negative. Triple sugar Iron (TSI) agar was also done to differentiate gram-negative rod bacteria. An oxidase test was done to differentiate Pseudomonas aeruginosa which is oxidase-positive from other oxidase-negative organisms. Antimicrobial susceptibility testing was done using the Kirby-Bauer disc diffusion test. The zone of inhibition was measured in millimetres and compared with the standard chart to determine susceptible, intermediate and resistant antibiotics to the test organisms.

The collected data was entered in a password-protected Microsoft Excel spreadsheet and then imported in SPSS version 26.0 for analysis.

Ethical Considerations

The study obtained ethical approval from the Research Ethics Committee (REC) of Gulu University under number MUST-2023-882. Administrative clearance from the Department of Internal Medicine Lira Regional Referral Hospital, and Lira Infectious Disease Centre were also obtained. All study participants provided informed consent. The study respected all principles of medical ethics as prescribed in the Declaration of Helsinki.

Results

A total of 180 participants were enrolled for participation (Figure 1). The culture was positive in 56 participants and negative in 124 participants. All 180 samples were negative for TB. The causative organisms and susceptibility patterns were determined in the 31.1% that had growth. The 56 participants received appropriate antibiotics for the isolated organisms were susceptible. Meanwhile, the 68.9% participants who had no growth had standard care according to the hospital procedure.

Baseline Characteristics of the Study Participants

The majority of the participants were female at 113 (62.8%) with a mean age of 45±12. The majority had a chronic cough 111 (61.7%). Fifty-two per cent of the participants had been living with HIV for less than 9 years and all were taking tenofovir, lamivudine and dolutegravir (TLD) combination therapy (Table 1).

Bacterial Isolates in the Sputum of HIV-Positive Patients Presenting with a Cough at LIDC

Bacterial growth was seen in 56 (31.1%). The commonest organism isolated was *Staphylococcus aureus* (35.7%), followed by *Pseudomonas aeruginosa* (19.6%), *Streptococcus pneumoniae* (17.9%), *Klebsiella pneumoniae* (12.5%) and *Enterobacter* species (8.9%) (Figure 2).

Susceptibility Patterns of the Bacterial Isolates Among HIV-Positive Patients Presenting with a Productive Cough at LIDC

In this study, as shown in Table 2 *Staphylococcus aureus* was sensitive to Imipenem, ceftriaxone and chloramphenicol but completely resistant to piperacillin-tazobactam. *Pseudomonas aeruginosa* was sensitive to Imipenem, ceftriaxone and ciprofloxacin. *Enterobacter* species were sensitive to gentamicin and Cefepime but completely resistant to ampicillin. *Klebsiella pneumoniae* was sensitive to Imipenem but completely resistant to azithromycin.

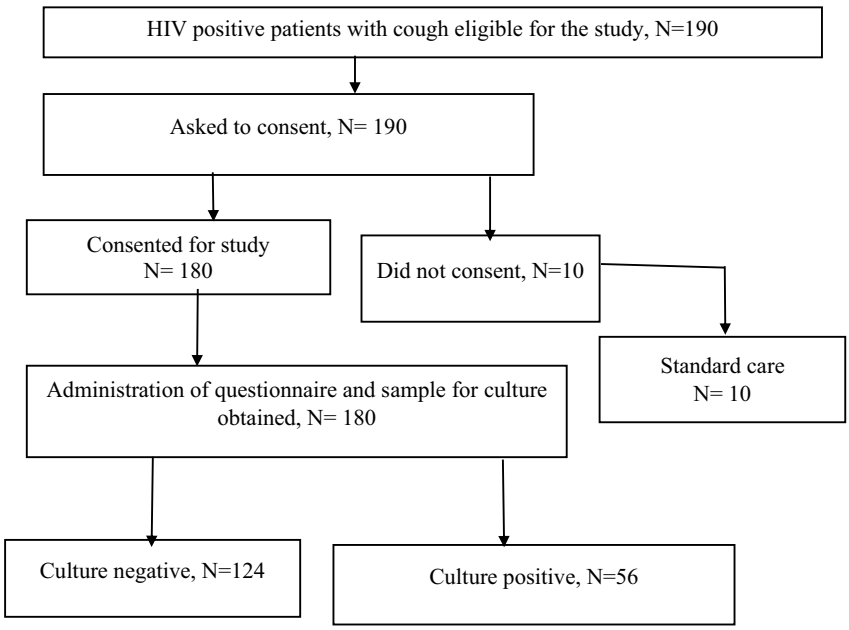

Figure 1 Showing study profile.

Table 1 Baseline Characteristics of Study Participants

Characteristic	Frequency	Percentage
Age (years) mean±SD	45±12	
≤45	105	58.3
>46	75	41.7
Sex		
Female	113	62.8
Male	67	37.2
Marital status		
Married	91	50.6
Widowed	39	21.7
Separated	23	12.8
Single	27	15.0
Education		
No formal education	42	23.3
≥Formal education	138	76.7
Smoking		
No	158	87.8
Yes	22	12.2
Alcohol use		
No	131	72.8
Yes	49	27.2
Recreational drug use		
No	176	97.8
Yes	4	2.2
Chest pain		
No	97	53.9
Yes	83	46.1
Fever		
No	161	89.4
Yes	19	10.6
Cough duration		
Acute	69	38.3
Chronic	111	61.7
HIV duration (years)		
< 9.00	94	52.2
≥9.00	86	47.8
ART duration (years)		
< 8.00	78	43.3
≥8.00	102	56.7
Viral load		
<200 copies	111	61.7
≥200	69	38.3
BMI		
18.5–24.9 Kg/m^2	105	58.3
≤18.49 Kg/m^2	16	8.9
≥25 Kg/m^2	59	32.8
Respiratory rate		
12–20 breaths per minute	160	88.9
≥ 21 breaths per minute	20	11.1

(*Continued*)

Table 1 (Continued).

Characteristic	Frequency	Percentage
Pulse rate		
60–99 beats per minute	150	83.3
≥ 100 beats per minute	30	16.7
SPO2		
95–100% on room air	138	76.7
≤ 94% on room air	42	23.3

Abbreviations: SD, Standard deviation; ART, Anti-retroviral therapy; BMI, Body mass index.

Factors Associated with Sputum Culture-Positive Cough Among HIV-Positive Patients at LIDC

At the bivariate level, the variables that had a p-value less than 0.2 and therefore qualified for multivariate analysis were age, education, viral load and peripheral oxygen saturation (Table 3). At the multivariate logistic regression (Table 4), an unsuppressed viral load (≥200 copies per millilitre of blood) (aOR=2.315, CI=1.386–3.868, P=0.001) and low peripheral oxygen saturation (of ≤94% on room air) (aOR=2.448, CI=1.472–4.073, P=0.001) were independently associated with a sputum culture-positive cough. A patient with an unsuppressed viral load was 2.315 times more likely to have a sputum culture-positive cough compared to one whose viral load was fully suppressed. A patient with low peripheral oxygen saturation was 2.448 times more likely to have a sputum culture-positive cough compared to one with normal peripheral oxygen saturation

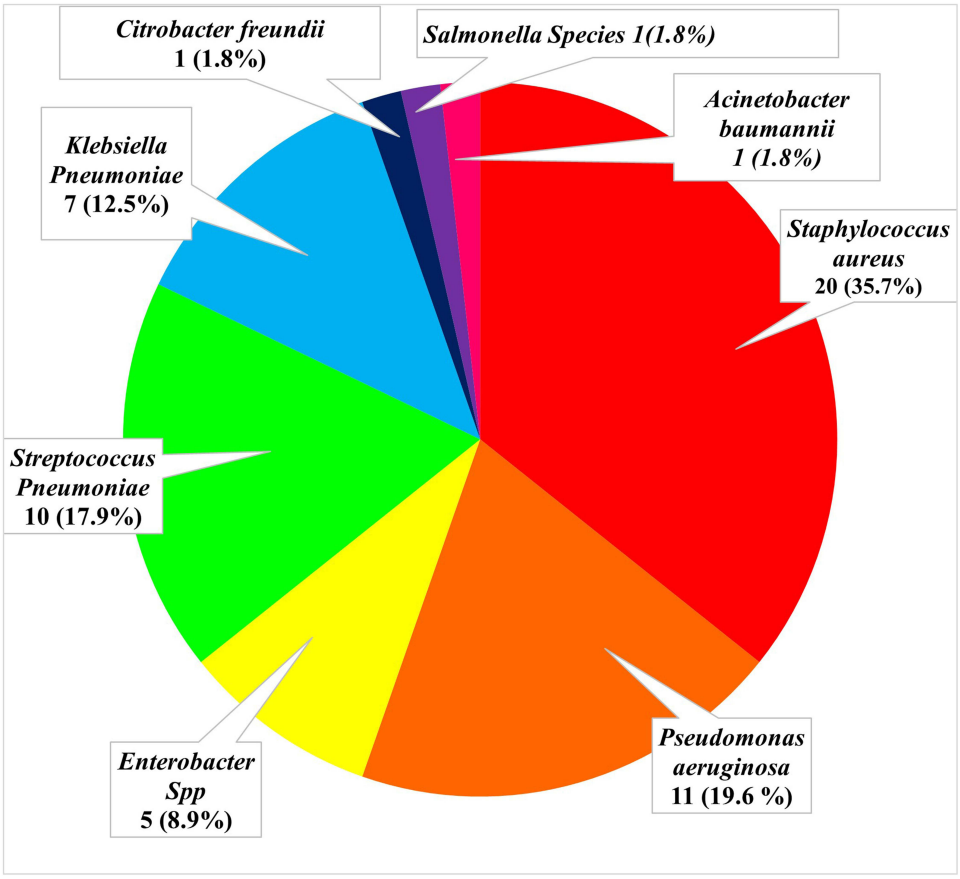

Figure 2 Showing bacterial isolates in the sputum of HIV-positive patients presenting with a productive cough at LIDC.

Table 2 Susceptibility Patterns of the Bacterial Isolates Among HIV-Positive Patients Presenting with Cough at LIDC

Organism		*Staphylococcus aureus* (N=20)	*Pseudomonas aeruginosa* (N=11)	*Enterobacter* Species (N=5)	*Streptococcus pneumoniae* (N=11)	*Klebsiella pneumoniae* (N=7)	*Citrobacter freundii* (N=1)	*Acinetobacter baumannii* (N=1)	*Salmonella* (N=1)
Imipenem	S	83.3%	81.8%	50.0%		100%	100%	100%	
	I			25.0%					100%
	R	16.7%	18.2%	25.0%					
Ceftriaxone	S	100%	75.0%	60.0%		42.9%			100%
	I					14.3%		100%	
	R		25.0%	40.0%		42.9%			
Ciprofloxacin	S	46.7%	90.9%	60.0%	20.0%	50.0%	100%	100%	
	I	20.0%		20.0%		16.7%			
	R	33.3%	9.1%	20.0%	80.0%	33.3%			
Gentamicin	S	63.2%	50.0%	80.0%	60.0%	40.0%	100%	100%	100%
	I	10.5%			20.0%	40.0%			
	R	26.3%	50.0%	20.0%	20.0%	20.0%			
Chloramphenicol	S	78.9%	16.7%		60.0%	80.0%			100%
	I		16.7%		10.0%				
	R	21.1%	66.7%		30.0%	20.0%		100%	
Tetracycline	S	50.0%			50.0%				
	R	50.0%			50.0%				
Cefepime	S		16.7%	80.0%					
	I		50.0%	20.0%					
	R		33.3%						
Amikacin	S		55.6%	40.0%					
	I						100%		
	R		44.4%	60.0%					

Azithromycin	S	50.0%			60.0%				
	I	16.7%							
	R	33.3%			40.0%	100%			
Co-trimoxazole	S	36.8%	20.0%	60.0%	10.0%	16.7%	100%		
	R	63.2%	80.0%	40.0%	90.0%	83.3%		100%	100%
Erythromycin	S	33.3%			20.0%				
	I	5.6%			30.0%				
	R	61.1%			50.0%				
Clindamycin	I	12.5%							
	R	87.5%			100%				
Piperacillin-tazobactam	S		12.5%	40.0%		14.3%		100%	
	I		50.0%	60.0%		28.6%			100%
	R	100%	37.5%			57.1%	100%		
Oxacillin	S	37.5%							
	R	62.5%			100%				
Ampicillin	S			100%			100%		
Amoxicillin	I								100%
	R					100%			
Cefuroxime	S					33.3%			
	R					66.7%			

Abbreviations: S, Sensitive; I, Intermediate; R, Resistant.

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Table 3 Bivariate Analysis of Factors Associated with Sputum Culture-Positive Cough Among HIV-Positive Patients at LIDC

Characteristic	Culture Negative, N=124	Culture Positive, N=56	Bivariate Analysis		
			cOR	95% CI	P value
Mean Age in years					
≤45	77(42.8)	28(15.6)	Ref		
>45	47(26.1)	28(15.7)	1.638	0.866–3.098	0.129
Sex					
Female	80(44.4)	33(18.3)	Ref		
Male	44(24.4)	23(12.8)	1.267	0.663–2.420	0.473
Marital status					
Married	61(33.9)	30(16.7)	Ref		
Widow	26(14.4)	13(7.2)	1.017	0.458–2.255	0.968
Separated	18(10.0)	5(2.8)	0.565	0.191–1.668	0.301
Single	19(10.6)	8(4.4)	0.856	0.336–2.180	0.745
Education					
Non formal	25(13.9)	17(9.4)	1.726	0.841–3.543	0.137
Formal education	99(55.0)	39(21.7)	Ref		
Smoking					
No	107(59.4)	51(28.3)	Ref		
Yes	17(9.4)	5(2.8)	0.617	0.216–1.766	0.368
Alcohol use					
No	91(50.6)	40(22.2)	Ref		
Yes	33(18.3)	16(8.9)	1.103	0.546–2.229	0.785
Chest pain					
No	66(36.7)	31(17.2)	Ref		
Yes	58(32.2)	25(13.9)	0.918	0.487–1.730	0.791
Fever					
No	109(60.6)	52(28.9)	Ref		
Yes	15(8.3)	4(2.2)	0.559	0.177–1.768	0.322
Cough duration					
Acute (<3 weeks)	48(26.7)	21(11.7)	Ref		
Chronic (≥3 weeks)	76(42.2)	35(19.4)	1.053	0.549–2.018	0.877
Mean HIV duration					
< 9.00 years	65(36.1)	29(16.1)	Ref		

(*Continued*)

Table 3 (Continued).

Characteristic	Culture Negative, N=124	Culture Positive, N=56	Bivariate Analysis		
			cOR	95% CI	P value
≥9.00 years	59(32.8)	27(15.0)	1.026	0.545–1.929	0.937
Mean ART duration					
< 8.00 years	52(28.9)	26(14.4)	Ref		
≥8.00 years	72(40.0)	30(16.7)	0.833	0.442–1.572	0.574
Viral load					
Suppressed (<200 copies of HIV per millilitre of blood)	81(45.0)	30(16.7)	Ref		
Unsuppressed (≥200 copies of HIV per millilitre of blood	43(23.9)	26(14.4)	3.514	1.675–7.372	0.001*
Body Mass Index					
18.5–24.9 Kg/m^2	74(41.1)	31(17.2)	Ref		
≤18.49 Kg/m^2	9(5.0)	7(3.9)	1.857	0.635–5.429	0.258
≥25 Kg/m^2	41(22.8)	18(10.0)	1.048	0.523–2.100	0.895
Respiratory rate					
12–20 breaths per minute	109(60.6)	51(28.3)	Ref		
≥21 breaths per minute	15(8.3)	5(2.8)	0.712	0.246–2.067	0.533
Pulse rate					
60–99 beats per minute	103(57.2)	47(26.1)	Ref		
≥100 beats per minute	21(11.7)	9(5.0)	0.939	0.400–2.206	0.886
Oxygen saturation					
95–100% on room air	98(54.4)	40(22.2)	Ref		
≤94% on room air	26(14.4)	16(8.9)	5.915	1.815–19.282	0.003*

Note: *Statistically significant p-value <0.05.
Abbreviations: Ref, Reference category, cOR, Crude odds ratio, CI, Confidence interval.

Discussion

The majority of the study participants were female with a mean age of 45±12 years. The majority had a chronic cough. The majority of the participants had been diagnosed with HIV for less than 9 years and all were taking ART. The fact that all patients were taking ART is an indicator of the improvement in the health care for HIV-positive patients in Uganda, in which any patient diagnosed with HIV is started on ART irrespective of the CD4 count in line with the current recommendations for HIV care. It was noted that the commonest organism isolated was *Staphylococcus aureus* accounting for 35.7% of all growths, followed by *Pseudomonas aeruginosa* (19.6%), *Streptococcus pneumoniae* (17.9%), *Klebsiella pneumoniae* (12.5%) and *Enterobacter Spp* (8.9%). The findings are in agreement with a report by Cilloniz et al[7] in South America, who isolated *Streptococcus pneumonia (30.2%), Staphylococcus aureus (1.8%), Pseudomonas aeruginosa* (1.2%) and *Klebsiella pneumonia (0.3%)*. This is also similar to reports by Bola O. and Oluyege[8] in Nigeria who isolated *Pseudomonas aeruginosa (35%), Staphylococcus aureus (20%)*, and *Klebsiella pneumonia (5%)* and Adhanom G et al[9] in Ethiopia who isolated *Klebsiella pneumonia (23.6%), Streptococcus pneumonia (15.5%), Klebsiella* species *(13.6%). Staphylococcus aureus (8.2%)* and *Enterobacter* species *6.0%)*. Still

Table 4 Multivariate Analysis of Factors Associated with Sputum Culture-Positive Cough Among HIV-Positive Patients at LIDC

Characteristic	Bivariate Analysis			Multivariate Analysis		
	cOR	95% CI	P value	aOR	95% CI	P value
Age (years)						
≤45	Ref					
>46	1.638	0.866–3.098	0.129	1.260	0.754–2.108	0.412
Education						
Non formal	1.726	0.841–3.543	0.137	1.537	0.906–2.607	0.142
Formal education	Ref					
Viral load						
Less than 200	Ref					
≥200	3.514	1.675–7.372	0.001	2.315	1.386–3.868	0.001*
SPO2						
95–100% on room air	Ref					
≤94% on room air	5.915	1.815–19.282	0.003	2.448	1.472–4.073	0.001*

Note: *Statistically significant p-value<0.05.
Abbreviations: aOR, Adjusted odds ratio; Ref, Reference category; CI, Confidence interval.

in agreement, Tilahun M et al[10] in Ethiopia isolated *Streptococcus pneumoniae* (28%), *Klebsiella pneumoniae* (26.3%) and *Pseudomonas aeruginosa* (19.4%) while Genetu DE and Zenebe Bahir Y[11] also in Ethiopia isolated *Staphylococcus aureus* (17%) and *Klebsiella pneumoniae* (27.9%). We noted that even the studies that isolated similar organisms as isolated in our study, had different percentages for the isolates, and these differences were noted across all studies. The study by Cilloniz et al included only those patients with a new infiltrate on chest radiography in addition to clinical signs and symptoms suggestive of lower respiratory tract infection, yet our study included all patients with a productive cough. The study by Bola. O & Oluyege enrolled all patients with pneumonia; however, the operational definition of pneumonia was not included in the published article. Adhanom et al enrolled patients with suspected pneumonia, but the details of inclusion were not specific since they depended on the diagnosis made by the clinician. The same methodology was used by Tilahun et al plus Genetu & Zenebe Bahir. Though all the studies used the same methods for bacterial isolation, the differences in the study populations could have contributed to the difference in the percentages. Contrary to our findings, Cilloniz C et al[7] in South America, Bola OO and Oluyege A[8] in Nigeria and Adhanom G et al[9] in Ethiopia all isolated *Escherichia coli* in addition to the above organisms, yet *Escherichia coli* was not seen in our study. However, in the study by Cilloniz et al only 1(0.3%) patient had *Escherichia coli*. Adhanom et plus Bola. O & Oluyege who isolated a large proportion of *Escherichia coli* did not have a clear definition of pneumonia, hence the differences in the methodology could explain the high proportions of E. coli in these studies. Moreover, *Escherichia coli* is a bacteria found in the GIT of humans and therefore, improper sputum sample collection could have contaminated the samples in the other studies whose methodology was not very clear resulting in high proportions of *Escherichia coli*. Also, a study by Spottiswoode N et al[12] at Mulago National Referral Hospital reported that despite not having been previously documented as a cause of pneumonia in patients with HIV, *Streptococcus mitis* was the most often found bacteria. It is also important to remember that the differences in the organisms isolated and the differences in the proportions of the isolates are evidence that the bacterial organisms causing cough among HIV patients vary widely from region to region. For this reason, there is a need to continuously assess the bacterial profile and continuously update the antibiogram for this category of patients.

Staphylococcus aureus was sensitive to Imipenem, ceftriaxone and chloramphenicol but completely resistant to piperacillin-tazobactam. *Pseudomonas aeruginosa* was sensitive to Imipenem, ceftriaxone and ciprofloxacin. *Enterobacter* species were sensitive to gentamicin and Cefepime but completely resistant to ampicillin. *Klebsiella pneumoniae* was sensitive to Imipenem but completely resistant to azithromycin. A combination of ceftriaxone and gentamicin was effective against most organisms isolated in this study, while piperacillin-tazobactam, oxacillin, co-trimoxazole and ampicillin had the highest resistance rates. With the exception of piperacillin-tazobactam, it has also

been noted that there is a higher resistance to oral drugs compared to intravenous drugs. The possible reasons could be because oral drugs are more easily obtainable over the counter, improper antibiotic use for a specific disease and incorrect doses or frequencies.[11] Also, poor socioeconomic status can be an exacerbating factor in that, patients cannot afford to buy adequate tablets for their diseases.[11] Thus, partial treatment leads to the survival of unscathed bacteria which reproduce resistant strains.[11]

In agreement with our findings, Adhanom G et al[9] in Ethiopia reported that 81%, 39.8%, and 24.5% of the isolates had penicillin, co-trimoxazole, and tetracycline resistance, respectively.[9] Furthermore, another study by Genetu DE and Zenebe Bahir Y[11] in Ethiopia reported that out of the tested drugs, 70.8% of *Pseudomonas aeruginosa* were resistant to co-trimoxazole. In Kampala, Okwera A et al[13] also reported that the *Streptococcus pneumoniae, Moraxella catarrhalis* and *Haemophilus influenzae* isolated were co-trimoxazole resistant.

Contrary to our findings, Genetu DE et al[11] in Ethiopia reported that out of the tested drugs, *Pseudomonas aeruginosa* was completely resistant to gentamycin, yet gentamicin demonstrated a good sensitivity in our study. Also, a study done in Kampala revealed that *Streptococcus pneumoniae, Moraxella catarrhalis* and *Haemophilus influenzae* were 100% susceptible to erythromycin,[13] yet erythromycin had a high resistance in our study.

Similar to our study, all other studies used the disc diffusion method to assess the susceptibility patterns and therefore the differences in susceptibility could not be attributed to the methods in the different studies. The differences in sensitivity patterns noted across studies can be explained by the differences in the resistance patterns which have been reported to depend on antibiotic stewardship. Also, the fact that co-trimoxazole is used for prophylaxis routinely among HIV-positive patients could have contributed to its resistance seen among most organisms. The third objective of this study was to determine the factors associated with sputum culture-positive cough among HIV-positive patients at LIDC. At the multivariate level of analysis, an unsuppressed viral load and low peripheral oxygen saturation were independently associated with a sputum culture-positive cough.

A patient with an unsuppressed viral load had 2.315 times more odds of having a sputum culture-positive cough compared to one whose viral load was fully suppressed, indicating that an unsuppressed viral load is a risk factor for developing a culture-positive cough. This agrees with a study conducted in Ethiopia, which discovered that the viral load was a statistically significant predictor of having a culture-positive cough.[10] Also, in another study conducted in Ethiopia, a recent viral load greater than or equal to 150 copies/mL (AOR= 24.3, 95% CI: 2.61–56.38), was found to have a statistically significant association with bacterial culture-positive pneumonia.[11]

The association between the viral load and sputum culture-positive cough is because an unsuppressed viral load of ≥200 copies per millilitre of blood increases the likelihood of developing respiratory opportunistic infections. This is in keeping with a study done in Spain that reported HIV patients who had a detectable viral load of ≥200 copies/mL of blood had a higher chance of developing *Streptococcus pneumoniae* in their sputum.[14]

A patient with low peripheral oxygen saturation had 2.448 times more odds of having a sputum culture-positive cough compared to one with normal peripheral oxygen saturation. The association seen between low peripheral oxygen saturation and having a sputum culture-positive cough is possible because complicated pneumonia causes ventilation perfusion mismatch resulting in reduced peripheral oxygen saturation.

Limitations

Due to financial restrictions, viral and fungal causes of cough could not be explored which could be possible causes of negative culture and sensitivity tests in patients with productive cough in this study.

The restrained duration of the study and the constraints to do other advanced investigations were a hindrance.

Conclusion and Recommendation

In our study, the commonest bacterial isolates were *Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pneumonia, Klebsiella pneumonia and Enterobacter* species among HIV patients with productive sputum, in Lira Infectious Disease Centre. A combination of ceftriaxone and gentamicin was effective against most organisms isolated in this study, while piperacillin-tazobactam, oxacillin and ampicillin had the highest resistance rates. An unsuppressed viral load and peripheral oxygen saturation of less than 95% were independently associated with a sputum culture-positive cough.

Most HIV patients at LIDC with productive cough associated and low oxygen saturation of ≤94% on room air with a viral load greater than 200 copies and above may be screened for *Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pneumonia, Klebsiella pneumonia* and *Enterobacter* species rather than testing tuberculosis only. Therefore, a combination of ceftriaxone and gentamicin may be used as empiric therapy before the culture and sensitivity results are available.

Further study assessing the causes of unsuppressed viral load among HIV-positive patients on ART may be done. The areas assessed may include adherence.

Author Contributions

All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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