

Incidence of tuberculosis and associated factors among HIV infected people who enrolled in the pre-ART and ART clinics of East Gojjam, North West Ethiopia

Sintayehu Abate^{1,2*}, Akberet Lemlem², Ibrahim Kedir², Tesfahun Melese¹, Fikreselassie Getachew, Getnet Kebede, Atalel Tarekegn, Sewnet Gedamu and Mamo Wubshet¹

¹University of Gondar, Gondar, Ethiopia

²Ethiopian Public Health Institute, P.O. Box 1242, Addis Ababa

*Corresponding author: sintayehuabat@yahoo.com, Cell phone: +251 912 4417 96

Abstract

Introduction: The interaction between tuberculosis and HIV infection is complex. These diseases present formidable challenges alone and together as well as pose a major threat to the international community's effort to achieve the health-related United Nations MDG for these infections. However, studies to understand the perspective of tuberculosis incidence among HIV infected people who enrolled in the chronic care units have been little in Ethiopia.

Objective: To determine incidence of tuberculosis and associated factors among chronic HIV care attendants.

Methods: A clinical-based retrospective cohort study was conducted from June to October 2012 in East Gojjam zone, Northern Ethiopia. All adults aged ≥ 15 years and enrolled in the chronic care units were included in the study. Data were retrieved by using a pre-tested and structured questionnaire; then entered and cleaned using EPI info version 3.5, 2008 statistical software. SPSS window version 16.0 was also employed for descriptive and logistics regression analysis.

Results: From a total of 964 study subjects, 39 of 482(8.1%) from the pre-ART group and 21 of 482(4.4%) from the ART group developed tuberculosis disease. Being widowed [AOR: 4.02; 95 % CI (1.22, 13.23)], low level hematocrit [AOR: 12.36; 95% CI (4.75, 32.19)], unable to take Cotrimexazole prophylaxis therapy [AOR: 5.89; 95% CI (2.37; 14.66)], below 350 cells/ml CD4 count [AOR: 7.7; 95% CI (2.37; 24.93)] from the pre-ART group and being widowed [AOR: 6.68; 95 % CI (1.07; 41.66)], low level hematocrit [AOR: 5.93; 95% CI (1.45, 23.61)], unable to take Cotrimexazole prophylaxis therapy [AOR: 0.071; 95% CI (0.021, 0.242)], below 350 cells/ml CD4 count [AOR: 10.05; 95% CI (1.26, 80.14)] from the ART group were some of the factors that had significant association with the incidence of tuberculosis.

Conclusions: In this study, the incidence of tuberculosis was high among pre-ART group than the ART group. Functional status, marital status, baseline hematocrit, CD4 count, Cotrimexazole prophylaxis therapy and WHO clinical stage had association with the incidence of TB. Therefore, initiation of ART regardless of CD4 count, viral load or using WHO clinical stage of HIV/AIDS plays a significant role in preventing the co-infection of tuberculosis.

Keywords: HIV, Tuberculosis, Incidence, pre-ART, ART

Introduction

The interaction between tuberculosis (TB) and human immunodeficiency virus (HIV) infection is complex (Daniel et al. 2008). HIV infection weakens the immune system and increases the likelihood of reactivation, reinfection and progression of latent TB infection to active disease (Sheela et al. 2010; Reuben et al. 2010). TB is the major opportunistic infection (OI) and leading cause of death among people with HIV (Gysje et al. 2010). Each disease presents formidable challenges alone and together (William et al. 2010) and their intricate linkage, poses a major threat to the international community (Haileyesus et al. 2010; Tajeldin and Abdellah 2010).

Magnitude of Tuberculosis and HIV: Since the initial description of HIV as the causative agent of AIDS, more than 60 million people have been infected with the virus, and more than 25 million people have died, globally (Macro et al. 2009). *Mycobacterium tuberculosis* infects 2 billion persons worldwide with

10 million new cases each year. Ninety percent of infected persons never develop clinical disease TB (WHO 2011; WHO et al. 2011). At least one-third of HIV-infected persons worldwide are infected with *Mycobacterium tuberculosis*, and 8% to 10% of them develop clinical disease every year (Soumya et al. 2010). It results in 3 million deaths per year of which 0.5 million deaths occur among HIV-infected persons which accounted for almost 13% - 25% of global AIDS-related mortality (Linda-Gail and Robbin 2010; Stephen and Robbin 2011).

Incidence of tuberculosis: The annual incidence of TB in Ethiopia is estimated to be 168 cases per 100,000 population for smear positive tuberculosis, and 379 per 100,000 populations for all cases with over all prevalence of 643 per 100,000 populations. The TB/HIV co-infection rate is 40-65% (Abera et al. 2009; Mekdes et al. 2011) but only 24% of HIV sero-prevalence is reported from health facilities implementing TB/HIV services (Aragie et al. 2012).

Risk factors: Studies done in Tanzania, Toronto and Uganda showed that health care delivery system, attitude of the community, level of HIV infection, CD₄ count, body mass index (marginally), marital status, sex, age, occupation and ART are the major factors that determine the incidence and mortality of HIV-associated TB (Macro et al. 2009, David et al. 2007; Richard et al. 2008). Priorities in addressing TB-HIV co-infection include instituting the World Health Organization (WHO)'s '3Is' (Intensified TB case-finding, Isoniazid preventive therapy and Infection control) (Gysje et al. 2010), and Cotrimexazole prophylaxis (Global TB HIV working group of the stop TB partnership 2009).

Several studies those have contradicted results were conducted in different countries on the incidence and associated factors of TB among patients in chronic HIV care units. In Ethiopia, although hospital-based cross sectional studies have reported that most of tuberculosis patients were co-infected with HIV, there is limited study conducted at East Gojjam zone though Amhara is the region most affected by HIV/AIDS (CSA 2012).

Materials and Methods

Study setting and population: A clinical based retrospective cohort study was carried out in East Gojjam zone, Northwest Ethiopia among pre- ART and ART clients enrolled between June 1, 2010 and May 30, 2012. Two hospitals and 14 health centers of the Zone were providing chronic HIV care services for 12,398 HIV infected people (East Gojjam zonal Health Department 2011).

Participants and data collection: All HIV clients those enrolled in the pre-ART and ART clinics of the Zone were considered as source population. All clients age greater than 15 who have been received chronic HIV care and HAART in pre ART and ART clinics within the stated duration were included in the study.

Sample size determination: Equation of two populations with equal sample size for difference of proportion was used to calculate the sample size. Patients on pre-ART were taken as non-exposed cohort and patients on ART were taken as exposed cohort. Epi Info version 3.5 2008 was used to calculate the required sample size for chart review. By taking confidence level 95%, power of the study 80%, expected frequency of disease in non-exposed group (cohort of pre-ART) 11.1% and relative risk (RR) 0.33 of (Arba Minch hospital), design effect 2, non-response rate 10 %, total sample size was 964 with ratio of exposed to non-exposed 1:1.

Six chronic HIV care units were selected by using simple random sampling technique since all care units

are homogeneous in their all over provision of care. From the selected care units, charts of study subjects retrieved in the clinics were obtained proportionally by systematic random sampling procedure. For the randomly chosen chart that did not fulfill the selection criteria, the next chart was included in the sample. TB status among the pre-ART and ART clients were reviewed from records. The collected records were assessed based on the required measurements and variables of study.

Ethical clearance was obtained from the Ethical Review Board of University of Gondar. Communication was made with concerned bodies. To keep confidentiality of any information provided regarding the study subjects, data collection procedure was anonymous.

Results

Socio demographic characteristics: A total of 964 client's charts (482 from each group) were included in the study. Among study subjects 197(40.9%) of pre-ART and 191(39.5%) of ART were found within the age range of 25-34 years. Four hundred thirty six (90.5%) of pre-ART and 410 (85.1%) of ART care attendants were followers of Orthodox Christian. Two hundred five (42.5%) and 227 (47.1%) of the pre-ART group and the ART group were married. Two hundred eighty three (58.7%) in pre-ART group and 266(55.2%) in ART group were not able to read and write (Table 1).

Clinical characteristics of study subjects: From the total of 964 chronic HIV care followers, 335(69.5%) of pre-ART and 251(52.1%) of ART had a functional status of "working". About 178(36.9%) of the pre-ART and 219 (45.4%) of the ART followers were WHO clinical stage III AIDS patients; 313(64.9%) of the pre-ART and 273(56.6%) of the ART care attendants had CD4 cells count <350cells/μl blood. CPT had taken by 379 (78.6%) of the pre-ART and 358 (74.3%) of the ART care followers; and from those, 339(87.3%) pre-ART clients started Cotrimoxazole prophylaxis within six weeks of knowing their sero-status. INH prophylaxis therapy was used by 18(3.7%) of pre-ART and 10 (2.1%) of ART care followers. Body mass index was evaluated for 423(87.8%) of the pre- ART care attendants.

Incidence of Tuberculosis: The overall cumulative incidence of tuberculosis was 6.2%, which was 8.1% in the pre-ART and 4.4% in the ART care followers. The highest incidence of TB was occur among females both in the pre-ART, 33(10.3%) and ART 15 (4.9%) groups. In both pre-ART and ART groups, clients with 15-44 years of age accounted the highest incidence of TB, which were 37(8.7%) and 18 (6.1%) respectively.

Table 1: Socio demographic characteristics of Pre ART and ART cohort in East Gojjam, Ethiopia, October 2012

Variable	Category	Number	
		Pre ART	ART
Age category	15-44	423(87.8)	296(61.4)
	45+	59(12.2)	186(38.6)
Sex	Male	161(33.4)	175(36.3)
	Female	321(66.6)	307(63.7)
Educational status	Not read and write	283(58.7)	266(55.2)
	Primary	103(21.4)	126(26.1)
	Secondary	61(12.7)	60(12.4)
	Tertiary	35(7.3)	30(6.2)
Religion	Orthodox	436(90.5)	410(85.1)
	Muslim	34(7.1)	58(12)
	Catholic	1(0.2)	12(2.5)
	Protestant	11(2.3)	2(0.4)
Marital status	Never married	117(24.3)	120(24.9)
	Married	205(42.5)	227(47.1)
	Widowed	108(22.4)	90(9.3)
	Divorced	52(10.8)	45(9.3)
Occupation	Civil servant	66(13.7)	82(17)
	Farmer	178(36.9)	171(35.5)
	House wife	66(13.7)	59(12.2)
	Commercial sex worker	41(8.5)	47(9.8)
	Merchant	71(14.7)	95(19.7)
	Student	36(7.5)	24(5)
	Others	24(5)	4(0.8)

It was utmost in individuals who were not able to read and write which was 32(11.3%) in the pre-ART and 13(4.9%) in the ART care followers. Concerning marital status, 19(17.6%) widowed from the Pre-ART group and 9 (10%) from ART group shared the peak burden of TB incidence.

Factors Associated with incidence of tuberculosis

The Pre-ART group: Incidence of tuberculosis had an association with clients' sex, educational status, marital status, functional status, baseline hematocrit, CD4 count, WHO clinical stage and Cotrimexazole preventive therapy (CPT). Males were less likely develop TB than females (AOR 0.312; 95% CI: 0.104, 0.939). Clients who were educated up to tertiary level had lower risk to develop TB than those who could not read and write (AOR 0.072; 95%CI: 0.007- 0.712). Widowed clients were 4 times more likely develop TB than those who never married (AOR 4.02; 95%CI: 1.222, 13.228). Bed ridden and ambulatory patients were 32.9 times (AOR 32.39; 95% CI: 8.079, 129.8) and 10.6 times (AOR 10.62; 95% CI: 3.756, 30) more likely to develop TB than those clients who were working respectively. Clients who had baseline hematocrit< 30% were 12.3 times more likely to develop TB than those had baseline hematocrit >30% (AOR 12.366; 95% CI: 4.75, 32.19). Clients with CD4 count <350 cells had 7.7 times greater risk for TB disease than those with >350 cells CD4 count (AOR 7.7; 95% CI: 2.378, 24.933). Those who were not on CPT had 5.89 times risk developing TB than those

who were on therapy (AOR 5.896; 95% CI: 2.37, 14.664). Furthermore, those who were in WHO clinical stage IV had 16.29 times the risk of developing TB as compared to those who had WHO clinical stage I-III (AOR16.29; 95% CI:3.88, 68.412)(Table 2).

The HAART group: In the multivariate analysis clients' marital status, functional status, WHO clinical stage, CD4 cells count, CPT, and base line hematocrit had significant association with the incidence of TB (Table 3). Widowed individuals on ART were 6.68 times more likely on risk to develop TB than those who never married (AOR 6.688; 95%CI: 1.07, 41.66). Bed ridden patients on ART were 9.94 times more likely on risk to develop TB than those who were working (AOR 9.94; 95%CI: 2.287, 43.194). Individuals with baseline hematocrit of <30% had 5.928 times risk to acquire TB compared to those with baseline hematocrit of >30% (AOR 5.928; 95%CI: 1.488, 23.61). ART group with CD4 cells count less than 350 were found to be 10.056 times more likely on risk to develop TB than those with CD4 cells count > 350 (AOR 10.056; 95%CI: 1.262, 80.147). Individuals who were on WHO clinical stage IV were 3.878 times more likely to be co-infected compared to individuals who were on WHO clinical stage of (I-III) (AOR 3.878; 95%CI: 1.235, 12.177). CPT reduced incidence of TB by92.9% (AOR 0.071; 95% CI: 0.021, 0.242).

Table 2: Factors associated with TB in the Pre-ART group of chronic HIV care units, East Gojjam, North West Ethiopia, October 2012

Variable	Tuberculosis		COR	95% CI	AOR
	Yes (%)	No (%)			
Sex					
Male	6(1.24)	155(32.16)	0.34(0.12, 0.87)		0.312(0.104, 0.939)
Female	33(6.85)	288(59.75)	1		1
Hematocrit					
<30%	24(5)	119(24.7)	4.36(2.11, 9.06)		12.366(4.75, 32.19)
>30%	15(3.1)	324(67.2)	1		1
CPT					
Yes	21(4.36)	358(74.27)	1		1
No	18(3.7)	85(17.6)	3.61(1.75, 7.43)		5.896(2.37, 14.664)
CD4 count					
<350 cells/	33(6.85)	280(58.1)	3.2(1.25, 8.7)		7.7(2.378, 24.933)
>350cells/	6(1.24)	163(33.8)	1		1
Educational Status					
Not read and write	32(6.85)	251(52.1)	1		1
Primary	4(0.83)	99(20.5)	0.32(0.09, 0.97)		0.298(0.088, 1.01)
Secondary	2(0.42)	59(12.24)	0.27(0.04, 1.18)		0.248(0.049, 1.247)
Tertiary	1(0.21)	34(7.1)	0.23(0.01, 1.66)		0.072(0.007, 0.712)
Functional Status					
Bed ridden	9(1.87)	34(7.1)	5.28(1.98, 13.9)		32.39(8.079, 129.8)
Ambulatory	14(2.9)	90(18.7)	3.1(1.37, 7)		10.62(3.756, 30)
Working	16(3.3)	319(66.2)	1		1
Marital Status					
Never married	7(1.45)	110(22.8)	1		1
Married	11(2.3)	194(40.25)	0.89(0.31, 2.63)		1.05(0.313, 3.494)
Widowed	19(3.94)	89(18.5)	3.35(1.26, 9.25)		4.02(1.222, 13.228)
Divorced	2(0.42)	50(10.4)	0.63(0.09, 3.48)		0.704(0.117, 4.247)
WHO Clinical Stage					
Stage I,II, and III	31	433	1		
Stage IV	8	10	11.17(3.7, 33.57)		16.29(3.88, 68.412)

Statistical significance for AOR at less than 0.05

Table 3: Factors associated with TB in the ART group in chronic HIV care units of East Gojjam, North West Ethiopia, October 2012

Variable	Tuberculosis		COR	95% CI	AOR
	Yes (%)	No (%)			
Age					
15-44 years	18(3.7)	278(57.7)	3.95(1.08, 17.1)		2.589(0.592, 11.33)
45+ years	3(0.6)	183(38)	1		1
Marital Status					
Never married	2(0.41)	118(24.5)	1		1
Married	7(1.45)	220(45.6)	1.88(0.35, 13.29)		2.507(0.4, 15.707)
Widowed	9(1.87)	81(16.8)	6.56(1.27, 45.18)		6.688(1.07, 41.66)
Divorced	3(0.62)	42(8.7)	4.21(0.55, 37.57)		4.55(0.518, 40.046)
Functional Status					
Bed ridden	10(2.07)	76(15.8)	10.88(2.67, 51.24)		9.94(2.287, 43.194)
Ambulatory	8(1.65)	137(28.4)	4.43(1.14, 23.35)		4.09(0.955, 17.585)
Working	3(0.62)	248(51.5)	1		1
Hematocrit					
<30%	18(3.73)	267(55.4)	4.36(1.19, 18.87)		5.928(1.488, 23.61)
>30%	3(0.62)	194(40.2)	1		1
CPT					
Yes	4(0.83)	354(73.4)	0.07(0.02, 0.23)		0.071(0.021, 0.242)
No	17(3.53)	107(22.1)	1		1
CD4 count					
<350 cells/	18(3.73)	253(52.5)	4.93(1.35, 21.35)		10.05(1.26, 80.14))
>350cells/	3(0.62)	208(43.1)	1		1
Duration of TB incidence on ART					
Within 6 months	15(3.11)	226(46.9)	2.59(0.55, 16.77)		0.949(0.161, 5.565)
Within 6-12 months	4(0.83)	157(32.6)	0.99(0.15, 8)		0.338(0.08, 1.434)
After 1 year	2(0.41)	78(16.2)	1		1
WHO Clinical Stage					
Stage I, II and III	13(2.9)	424(88)	1		1
Stage IV	8(1.6)	37(7.5)	7.05(2.48, 19.72)		3.878(1.23, 12.177)

Statistical significant at p-value < 0.05

Discussion

The overall cumulative incidence of TB was 6.2%, which is in line with studies done in Kenya (6.2%) (NACC and NASCOP 2012), Uganda (6.4%) (William et al. 2011), but lower than the study conducted in other Sub-Saharan African countries which was >10% (Hayleyesus et al. 2010). Likewise, incidence of TB in the pre-ART group (8.1%) was lower than the study reported from Somaliland (>10%) (Ahmed 2008), and from another study conducted in Zimbabwe which was 25.3% (Elizabeth 2007).

Pre-ART: Incidence of tuberculosis among pre-ART clients was 8.1%, which is almost twice of those who initiated HAART (4.4%). The possible reason could be the fact that ART increases the immunity and decreases the viral load hence decreases the incidence of TB. But unmasking of the undiagnosed OI and “paradoxical” IRIS when an opportunistic infection (OI) diagnosed pre-ART initially responds to treatment but then deteriorates following ART initiation could be the possible reasons for TB after initiation of the ART (Lewis et al. 2012). The study showed that clients’ sex, educational status, marital status, functional status, Cotrimexazole prophylaxis, baseline hematocrit, CD4 cells count and WHO clinical stage had significant association with the incidence of tuberculosis in the pre-ART group. The risk to develop TB was higher in females than in males, which is similar to a survey done in Cape Town which showed women aged 15-24 have rates of TB 1.5–2-fold higher than men of the same age (Graeme et al. 2008; Theosmart 2012). But the present result is in contrast to study done in South West Ethiopia which was higher in males (Mohamed and Fasil 2011). Clients those not able to read and write had higher risk of developing TB than those who had primary educational level. Widowed individuals of pre-ART group were 4 times more likely to develop TB as compared to the unmarried. Bedridden and ambulatory patients had higher risk to develop TB than those who were working which is in line with a study done in Tanzania (Richard et al. 2008). Patients with CD4 cell count of <350cells/μl had more chance for the predictor of TB incidence which is consistent with a study done in South West Ethiopia (Mohammed and Fasil 2011) and other studies carried out in eleven countries from different regions of the world (Amitabh and Suthar 2012; Tajelidin and Abdallah 2010; Stephen and Robbin 2011; Lewis et al. 2012) which a 5% decrease in TB disease risk for every increase in the CD4 count of 10 cells/mm³, and an increase of 24% in the risk of TB disease for every year after HIV diagnosis (Tolu-Oni and Rolebohile 2011). Pre-ART clients with low level of base line hematocrit level had more chance of developing TB than those with higher

hematocrit level which is relatively similar to studies done in South West Ethiopia (Mohammed and Fasil 2011) and Durban (Lewis et al. 2012). CPT reduced incidence of tuberculosis among pre-ART cohorts by 94.1% which is similar to a study done in Kenya (92%) (American Medical Association 2011) but higher than a study conducted in Cote d’Ivoire (46%) (Elizabeth et al. 2008). Furthermore, those who were in WHO clinical stage IV had the risk of developing TB by 16.29% as compared to those who were WHO clinical stage (I-III).

ART: The cumulative incidence of TB among ART group was 4.4%, which is half of the pre-ART group in agreement with a study done in Kampala, Uganda (4.3%) (David et al. 2007, William et al. 2011), but lower than a study done in South Africa (24.7%) (Katharino et al. 2010). Incidence of TB in the ART group had significant association with marital status, functional status, Cotrimexazole prophylaxis, baseline hematocrit, CD4 cells count and WHO clinical stage. Widowed individuals of the ART group were 6.688 times more likely to develop TB as compared to the unmarried. Bedridden patients had 9.94 times higher risk to TB incidence than those who were working which is in line with a study done in Tanzania (Richard et al. 2008). CPT reduces TB incidence by 92.9% which was in line with a study done in different Sub Saharan African countries by the Johns Hopkins University (Timothy et al. 2010). Those who had base line hematocrit <30% had 5.928 times more likely of developing TB. Those who were WHO clinical stage IV AIDS patients were 3.878 times more likely to develop TB than those in WHO clinical stage (I-III) which coincides with the report of WHO (Mathew 2008). Patients with CD4 count <350cells/μl were more likely to develop TB which is similar to studies done in rural Northern Tanzania (Bernard et al. 2008), in nine Sub-Saharan African countries, and a report of International AIDS society conference (Soumya et al. 2010; Anthony et al. 2010; Benjamin et al. 2009).

Conclusion

In this study, incidence of TB was higher in the pre-ART cohorts than the ART cohorts that indicate HAART is strongly associated with a reduction in tuberculosis incidence. Marital status, functional status, base line CD4 cell count, base line hematocrit level, Cotrimoxazole prophylaxis therapy and WHO clinical stage had significant association with incidence of TB in both pre-ART and ART cohorts. However, sex and educational status had association only with those in the Pre-ART cohorts. Therefore, universal access to ART despite their WHO clinical stage, CD4 or viral load level is required to reduce and protect the co-infection of TB in individuals with HIV.

Acknowledgement

The authors would like to acknowledge University of Gondar for all rounded support. East Gojjam Zonal Health Department and Health Facilities under the Zone are acknowledged for their overall support and providing the necessary information.

References

- Abera B, Kate F, Zelalem H, & Andrew F (2009). The association of TB with HIV infection in Oromia Regional National State, Ethiopia in 2006/7. *Ethiopian Journal of Health Development*, 23(1): 63-67.
- Ahmed HO (2008). Tuberculosis and HIV infection in two Districts. Academic Dissertation, 1-27.
- Andrea AH & Wafaa ME (2010). Integration of Tuberculosis and HIV Services in Sub-Saharan Africa: Lessons Learned. *Infectious Diseases Society of America*, 50(3):238-244.
- Aragie K, Degu J, Yibeltal A, Azmera T, Abraham A, & Amare D (2012). Evaluation of Collaborative TB/HIV activities in a general hospital in Addis Ababa, Ethiopia. *BMC*, 5(67).
- Central Stastical Agency (2012). Ethiopia Demographic and Health Survey, pp 430
- Corbett EL, Bandason T, Cheung YB, Munyati S, Godfrey-Faussett P, Hayes R, et al. (2007). Epidemiology of Tuberculosis in a High HIV Prevalence Population Provided with Enhanced Diagnosis of Symptomatic Disease. *PLoS Medicine*, 4(1):164-172.
- Datiko DG, Yassin MA, Chekol LT, Kabeto LE & Lindtjörn B (2008). The rate of TB-HIV co-infection depends on the prevalence of HIV infection in a community. *BMC Public Health*, 8(266):1471-2458.
- Elizabeth L, Barbara M, Gavin J & Kevin M (2008). Tuberculosis in sub-Saharan Africa: opportunities, challenges, and change in the era of antiretroviral treatment. *Lancet*, 367: 926-37.
- East Gojjam Zonal Health Department (2011). *Annual Report of the Zone Health Activities*, 1-39.
- Graeme M, Hennie S, Chelsea M, Douglas Wilson & Gary M (2008). Patient and provider delay in tuberculosis suspects from communities with a high HIV prevalence in South Africa: A cross-sectional study. *BMC Infectious Diseases*, 8(72):1471-2334.
- Global TB/HIV Working Group of the Stop TB Partnership (2009). Scaling up prevention and treatment for TB and HIV Stop TB Partnership.
- Gysje J P, Enny K, Dina BL, Govert W, Emiliana T, Ric NP, et al. (2010). The burden and treatment of HIV in tuberculosis patients in Papua Province, Indonesia: a prospective observational study, *BMC I*, 10(362):1471-2334.
- Haileyesus G, Christian G, Reuben G & Paul N (2010). HIV Infection–Associated Tuberculosis: The Epidemiology and the Response. *Infectious Diseases Society of America*, 50(3):201-207.
- Harries AD, Zachariah R, Corbett EL, Lawn SD, Santos-Filho ET, Chimzizi R, et al. (2010). The HIV-associated tuberculosis epidemic - When will we act? *Infectious and Tropical Diseases*, 375 (10):1906 -1919.
- Ibrahim S, Imke S, Mesach M, Maarten S, Frank C, & Joseph KL (2010). Low HIV testing rates among tuberculosis patients in Kampala, Uganda. *BMC Public Health*, 177(10):1471-2458.
- Katharina K, Rein MH & Judith RG (2010). Yield of HIV-associated tuberculosis during intensified case finding in resource-limited settings: a systematic review and meta-analysis. *Infectious Diseases Society of America*, 10(2):93-102.
- Lewis JH, Mahomed-Yunus SM, Anisa M, Pravi M, Raveen P & Philippa JE (2012). Incidence, Clinical Spectrum, Risk Factors and Impact of HIV-Associated Immune Reconstitution Inflammatory Syndrome in South Africa. *PLoS ONE*, 7(11):1-12.
- Linda-Gail B1 & Robbin W (2010). The Changing Natural History of Tuberculosis and HIV Coinfection in an Urban Area of Hyperendemicity. *The Infectious Diseases Society of America*, 15; 50(3): S245–S254.
- Mark H. Treatment Action Group (2010). From HIV to Tuberculosis and Back Again: A Tale of Activism in 2 Pandemics. *Clinical Infectious Diseases*, 50(3):260-266.
- Matthew MK (2008). Living with HIV, Dying of Tuberculosis. *GMHCTreatment Issue*, 1-8.
- Mekdes KG, Gunnar AB & Jan CF (2011). Lay beliefs of TB and TB/HIV co-infection in Addis Ababa, Ethiopia: a qualitative study. *BMC*, 4(277): 2-5.
- Mohammed T, Amare D, Fasil T, Sahilu A, Luc D & Robert C (2011). Risk factors of active Tuberculosis in people living with HIV/AIDS in South West Ethiopia: a case control study. *Ethiopian Journal of Health Sciences*, 21(2):131–139.
- Moore D, Liechty C, Ekwaru P, Were W, Mwima G, Solberg P, et al. (2007). Prevalence, incidence and mortality associated with tuberculosis in HIV-infected patients initiating antiretroviral therapy in rural Uganda. *AIDS Journal*, 30; 21(6):713-9.
- Oliver BG, Elliott JH, Price P, Phillips M, Saphonn V, Vun MC, et al. (2009). Mediators of Innate and Adaptive Immune Responses Differentially Affect Immune Restoration Disease Associated with Mycobacterium tuberculosis in HIV Patients

- Beginning Antiretroviral Therapy. *Journal of Infectious Diseases*, 202(11):1728-1737.
- Suthar AB, Lawn SD, del Amo J, Getahun H, Dye C, Sculier D, et al. (2012). Antiretroviral Therapy for Prevention of Tuberculosis in Adults with HIV: A Systematic Review and Meta-Analysis. *PLoS Medicine*, 9e1001270(7).
- Vitoria M, Granich R, Gilks CF, Gunneberg C, Hosseini M, Were W, et al. (2009). The Global Fight Against HIV/AIDS, Tuberculosis, and Malaria. *American Society for Clinical Pathology*, 131:844-848.
- NACC & NASCOP (2012). Kenya AIDS Epidemic update 2011. *National Aids and STI Control Programme*, 1-123.
- Open Society Institute's Public Health Programme Treatment Group (2006). Civil Society Perspectives on TB/HIV Public Health Watch.
- Panos Ethiopia (2009). Media coverage of HIV/AIDS and TB issues in Ethiopia. *Panos East Africa*.
- Haileyesus G, Reuben G, Delphine S, Christian G, Leopold B, Paul N, et al. (2010). Implementation of isoniazid preventive therapy for people living with HIV worldwide: barriers and solutions. *Infectious Diseases Society of America*, 50(3):215-222.
- Muhammad B, Robert DA, Lillian M, Johnson L, Richard W, Mecky M, et al. (2008). Basis for treatment of tuberculosis among HIV-infected patients in Tanzania: the role of chest x-ray and sputum culture. *BMC Infectious Diseases*, 8(32):1471-2334.
- Sheela V, Shenoi A, Roderick E & Gerald F (2010). Transmission of Drug-Susceptible and Drug-Resistant Tuberculosis and the Critical Importance of Airborne Infection Control in the Era of HIV Infection and Highly Active Antiretroviral Therapy Rollouts. *Clinical Infectious Diseases*, 50(3):231-237.
- Soumya S, Padmapriyadarsini C & Narendran G (2010). HIV-Associated Tuberculosis: Clinical Update. *Clinical Infectious Diseases Society of America*, 50(10):1377-1386.
- Stephen DL & Robbin W (2011). Poor Prognosis of HIV-Associated Tuberculous Meningitis Regardless of the Timing of Antiretroviral Therapy. *Clinical Infectious Diseases*, 52(11):1374-1383.
- Tajeldin MA, Mohammed FS, Abdel A & AbdAllah A (2011). Seroprevalence of HIV infection among tuberculosis patients in Kassala, eastern Sudan. *Journal of AIDS and HIV Research*, 3(8):161-163.
- Theo Smart T (2012). TB, HIV, Mothers and Children: Time for action; HATIP AIDS map, (188):1-12.
- Timothy R, Sterling PA & Richard EC (2010). HIV Infection-Related Tuberculosis: Clinical Manifestations and Treatment. *Clinical Infectious Diseases*, 50(3):223-230.
- Tolu-Oni RB & Relebohile T (2011). High prevalence of subclinical tuberculosis in HIV-1-infected persons without advanced immunodeficiency: implications for TB screening. *Infectious Diseases and Molecular Medicine*, 66:669-673.
- William L, Coggin C & Charles BH (2010). Role of the US President's Emergency Plan for AIDS Relief in Responding to Tuberculosis and HIV Coinfection. *Clinical Infectious Diseases*, 50(3):255-259.
- William W, Marguerite ML, Harriet MK, Jane N, Andrew K, Yukari C, et al. (2011). Antiretroviral Treatment-Associated Tuberculosis in a Prospective Cohort of HIV-Infected Patients Starting ART Clinical and Developmental Immunology, 1-9.
- World Health Organization (2011). Retention in HIV programmes. Defining the challenges and identifying solutions. *Meeting Report*.
- World Health Organization/UNAIDS/UNICEF (2011). Global HIV/ AIDS Response. Epidemic update and health sector progress towards Universal Access. *Progress Report*.