Rapid Molecular Testing of Sputum for Identification of Pulmonary Tuberculosis: Impact on Duration of Respiratory Isolation

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Utilization of molecular techniques to improve use of airborne infection isolation are recommended

Our study demonstrated that the use of the GeneXpert/MTB RIF platform for direct testing in sputum samples was accurate in diagnosing TB, significantly reduces airborne infection isolation duration, and reduced turnaround time of results

Introduction

- Current guidelines recommend molecular testing directly on sputum of patients with suspected pulmonary tuberculosis (TB) to facilitate discontinuation of airborne infection isolation (AII).
- Molecular testing of sputum using GeneXpert/MTB RIF (Xpert; Cepheid) (GXTB) was implemented at Henry Ford Health System on March 2019.
- We evaluated the impact of GXTB on duration of AII over a 2-year period: Pre-implementation and post-implementation.
- Providers were permitted to remove patients from AII using 3 negative acid-fast bacillus smears (AFB) or 2 negative GXTB results.
- Primary endpoint was time on AII, secondary endpoints included turn-around-times (TAT), and length of stay.

Methods

- Pre-implementation period from January 2018 to February 2019 and post-implementation from March 2019 to February 2020.
- Post implementation phase, AFB smear and culture, were still performed in parallel of GXTB testing.
- Demographic data, TB risk factors, duration of AII, length of hospital stay (LOS), accuracy and TAT for AFB and GXTB were compared in the pre- and post-implementation periods.
- Categorical variables were studied using chi-square testing, and continuous variables were studied using T-test or Mann Whitney U test as appropriate.

Results

- 269 patients with suspected TB were placed in AII: 137 pre and 132 post-implementation.
- Clinical characteristics and TB risk factors were generally comparable in both groups (**Table 1**).
- Abnormal chest X-ray was more frequent in patients in the post-implementation phase.
- All cases of culture positive TB were detected by AFB and GXTB. There we no false positives with GXTB.
- TAT of AFB results before and after implementation were similar and ranged from 20-24 hours (**Table 2**).
- In the post-implementation period, TAT of GXTB compared to AFB was 6.35 vs 21.28 hours (p <0.0001).
- Duration of AII was shortened by almost 24 hours (70.2 vs 93.7 hours, p=0.031) (**Table 3**).
- Time from first sample collection to final results of all samples was 19.2 vs 52.6 hours, p<0.0001.
- There was no difference in total LOS pre and post-implementation.

Table 2. Turnaround times (TAT) of AFB and GeneXpert/MTB (Xpert) RIF before and after implementation

Phase	TAT (N)	Median	IQR
Pre-implementation N=137	AFB1 (N=126)	21.3	12.9-28.4
	AFB2 (N=115)	23.9	11.8-30.0
	AFB3 (N=105)	21	10.8-31
Post-implementation N=132	AFB1	23.6	14.7-30.4
	AFB2	24.8	18.9-30.8
	AFB3	21	11.7-28.2
	Xpert 1	6.4	4.3-13.4
	Xpert 2	6.2	4.5-10.1

Abbreviations: CI, confidence interval; HFHS PCP, PCP from Henry Ford Health System.
* Represents p-value <0.05.

Table 3. Duration of Airborne Isolation, Total Turnaround times, and Hospital length of stay in the Pre- and Post-implementation period

Variable	Pre-implementation	Post-implementation	*P* value
Duration of airborne isolation (Mean, SD) Hours	93.7 (111.7)	70.2 (44.6)	0.031
Total turnaround time a (Mean, SD) Hours	52.6 (41.1)	19.2 (15.9)	<0.0001
Length of stay in hospital (Mean, SD) Hours	10.5 (11.8)	9.7 (6.9)	0.496

Abbreviations: SD, standard deviation. [a] Total turnaround time, time from first sample collection to final result of all samples.

Conclusion

- Implementation of rapid direct molecular testing reduced the duration of respiratory isolation for patients with suspected pulmonary TB.
- Further provider education regarding the reliability of GXTB in excluding TB may be necessary to reduce overall hospital LOS.

Results

Table 1: Clinical Characteristics of Patients with suspected Pulmonary Tuberculosis

Variable	Pre N=137	Post N=132	P value
Age in years – median IQR	59 (48-70)	58 (44-67)	0.224
Male sex, N(%)	89 (65)	88 (66.7)	0.769
Race, N (%)			0.402
White	40 (29.2)	36 (27.3)	
Black	70 (51.1)	79 (59.9)	
Asian	5 (3.7)	3 (2.3)	
Other	22 (16.1)	14 (10.6)	
PPD positive, N (%)	7 (5.1)	10 (7.6)	0.406
IGRA positive/indeterminate, N (%)	40 (29.2)	24 (18.2)	**0.034**
LTBI, N (%)	22 (16.1)	23 (17.4)	0.764
TB history, N (%)	22 (19.7)	13 (9.9)	**0.023**
HIV infection, N (%)	18 (13.1)	25 (18.9)	0.194
Substance abuse, N (%)	50 (36.5)	40 (30.3)	0.282
IVDU, N (%)	18 (13.1)	13 (9.9)	0.398
TB contact, N (%)	21 (15.3)	16 (12.1)	0.445
Homelessness, N (%)	18 (13.1)	12 (9.1)	0.292
Incarceration, N (%)	26 (20)	20 (15.2)	0.405
Health care worker, N (%)	1 (0.7)	1 (0.7)	1
Cancer, N (%)	22 (16.1)	11 (8.3)	0.054
Transplant, N (%)	6 (4.4)	4 (3.0)	0.749
Autoimmune disease, N (%)	14 (10.2)	9 (6.8)	0.319
Immunosuppressed, N (%)	46 (33.6)	39 (29.6)	0.477
Born outside USA, N (%)	20 (14.6)	18 (13.6)	0.821
Signs/Symptoms/Radiology, N(%)			
Fever	49 (35.8)	53 (40.2)	0.459
Chills	36 (26.3)	37 (28.0)	0.747
Shortness of breath	83 (60.6)	74 (56.1)	0.452
Cough	92 (67.2)	84 (63.6)	0.544
Hemoptysis	36 (26.3)	30 (22.7)	0.499
Night sweats	16 (11.7)	31 (23.5)	**0.011**
Weight loss	43 (31.4)	46 (34.9)	0.546
Asymptomatic	11 (8.0)	19 (14.4)	0.097
Abnormal CXR	95 (69.3)	115 (87.1)	**0.0004**
Abnormal CT chest	112 (81.8)	111 (84.1)	0.611
AFB smear positive, N (%)	17 (12.4)	13 (9.9)	0.505
Any mycobacterial culture positive, N (%)	34 (24.8)	20 (15.2)	**0.048**
MTB culture positive, N (%)	4 (2.9)	5 (3.8)	0.954
NTM culture positive, N (%)	30 (23.4)	15 (12.1)	**0.030**

Abbreviations: IQR, interquartile range; PPD, purified protein derivative; IGRA, interferon gamma release assay; LTBI, history of latent tuberculosis infection; TB, Mycobacterium tuberculosis; HIV, human immunodeficiency virus; IVDU, intravenous drug use; CXR, chest X-ray; CT, cat scan; USA, United States of America; AFB, acid fast bacillus smear; *, p value <0.005.