Review Article

Journal of Biochemistry and Biophysics
Volume 9 Number 2, July - December 2024
DOI: http://dx.doi.org/10.21088/rfpjbb.2582-3558.9224.4

Technology Playing Crucial Role in Early Diagnosis of Tuberculosis

Sachin C. Narwadiya

How to cite this article:

Sachin C. Narwadiya, Technology Playing Crucial Role in Early Diagnosis of Tuberculosis. RFP Jour. of Bio. and Biophy. 2024;9(2): 127–130.

Abstract

Tuberculosis is a deadly disease that has hovered humanity for numerous decades. It's caused by *Mycobacterium tuberculosis*. Tuberculosis(TB) exploration and invention are critical to achieving global TB targets that will help reduce TB prevalence and TB- related deaths. The WHO End Tuberculosis Strategy, espoused in 2014, envisages a 17 periodic decline in global TB prevalence between 2025 and 2035, compared to a reference line of 2 annually in 2015 and 20 in 2016. It's conceded that achieving the unknown decline from 2025, it'll bear significant technological advances, similar as the development of new TB vaccines that can be used both ahead and after infection by 2025." Progress in exploration and invention" is the third pillar of the final TB law.

Keywords: Diagnosis; Tuberculosis; Technology; Xpert MTB/ RIF.

INTRODUCTION

A crucial step in tuberculosis(TB) care is rapid-fire and accurate TB testing. In recent times, specific and sensitive rapid-fire molecular tests have revolutionized the opinion of TB, which was preliminarily grounded on microscopy and culture. TB positive is defined as "bacteriologically verified" TB by side inflow urine lipoarabinomannan (LF-getaway) testing or foam smear microscopy. Microbiological testing for TB is important because it allows people to make a correct opinion and start the stylish treatment as early as possible. Those diagnosed with TB without bacteriological results are classified as "diagnosed with TB." Viral testing is needed to descry primary and secondary antibodies to pneumonia.[3]

An aggregate of 6.4 million people was recently diagnosed and reported with tuberculosis worldwide in 2021; the proportion of bacteriological conditions worldwide has increased in recent times, from 59 in 2020 to 63 in 2021. The largest share is in Europe and the Americas, with other regions not yet rising to a similar position.

In a political protestation held at the First United Nations(UN) High- Level Meeting on Tuberculosis(TB) on 26 September 2018, Member States committed to four new global targets. One target is to diagnose and treat 40 million TB cases

Author's Affiliation: [1]Scientist D, Institute of Advanced Study in Science and Technology, Guwahati, Assam 781035, India.

Corresponding Author: Sachin C Narwadiya, Scientist D, Institute of Advanced Study in Science and Technology, Guwahati, Assam 781035, India.

E-mail: snarwadiya@gmail.com

Received: 11.09.2024 **Accepted:** 25.11.2024

This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0.

in the 5 times from 2018 to 2022. The target breaks down to roughly 7 million people per time in 2018.[4]

The World Health Organization(WHO) provides an estimate of the global prevalence of isoniazid resistance in 2019, there were 1.4 million cases of isoniazid- resistant tuberculosis, of which 1.1 million were susceptible to rifampin.

1. numerous are not diagnosed with anti-TB medicines and do not admit applicable treatment. The DST) highlights the important part of laboratories in the rapid-fire and accurate discovery of TB and vaccination after 2015.
2. Of the 7 million new and returning cases reported in 2018, 5.9 million had TB. Among these, 55 were verified bacteriological conditions, a slight drop from 56 in 2017 and 58 in 2013. Abnormalities or reported histology.[1]

World Health Organization's Recommendations 1 original tests for estimation of TB with medicine-resistance detection.

In grown-ups with signs and symptoms of pulmonary TB

- Xpert MTB/ RIF should be used as individual test for TB and RR discovery in foam rather than smear microscopy/ culture and pDST.
- And without a previous history of TB (≤ 5 times) or with a remote history of TB Tx (> 5 times since end of Tx), Xpert Ultra should be used as individual test for TB and RR discovery in foam, to replace smear microscopy/ culture and pDST.
- And with a previous history of TB and an end of Tx within the last 5 times, Xpert Ultra may be used as individual test for TB and for RR discovery in foam, to replace smear microscopy/ culture and pDST.
- And Xpert Ultra trace positive result on the original test, repeated testing with Xpert Ultra may not be used.[1]

In children with signs and symptoms of pulmonary TB

Xpert MTB/ RIF or Xpert Ultra should be used as individual test for TB and RR in foam, GA, NPA and coprolite rather than smear microscopy/ culture and pDST.

- In settings with pretest probability below 5 and an Xpert negative result on the original test, repeated testing with Xpert MTB/ RIF or Xpert Ultra in foam, gastric fluid, nasopharyngeal aspirate or coprolite samples may not be used.
- In settings with pretest probability 5 or further and an Xpert negative result on the original test, repeated testing with Xpert MTB/ RIF or Xpert Ultra(for aggregate of two tests) in foam, gastric fluid, nasopharyngeal aspirate and coprolite samples may be used.[1]

Nucleic acid testing (NAT)

Nucleic acid testing (NAT) is a system used to hit upon nucleic acid sequences. Generally, NAT is used to discover and pick out precise pathogens or pathogens (together with disease- causing contagions or bacteria in the blood, apkins, or urine). NATs differ from other assessments in that they stumble on inheritable cloth(RNA or DNA) in preference to antibodies or both(it generally takes time for antibodies or antibodies to start to feel in the blood. Because inheritable cloth is generally low in quantum, numerous NATs correspond of way to round the inheritable material(as an illustration, making further than one clones)- a kind of NAT called a nucleic acid modification test(NAAT).[5] The inheritable cloth is amplified using the polymerase chain reaction (PCR) system, a popular system that calls for thermal cycling. still, a many strategies, which include the circle- intermediated isothermal modification(Beacon) system, do now not cycle but operate isothermally. Modification ways can come across amplicons incontinently the operation of fluorescent widgets, in which different strategies bear visual analysing. In general, four generation companies and 4 products are proposed Phenotypic Examinations Smear microscopy of acid-speedy bacilli(AFB) is the simple and maximum astronomically to be had individual approach for the prognostic of pulmonary TB(PTB).[6] Despite its benefits like cost effectiveness, ease of use, and operation in resource- confined settings, the important disadvantage of smear microscopy consists of its drop perceptivity (50 – 60) which has dropped its use in recent times. Another trouble of those molecular exams is the lack of differentiation among silent mutations from the mutations that bog down drug efficacy, resulting in an expanded fee of fake resistance results. Eleven in such times, whole genome sequencing (WGS) gives a complete analysis of the complete MTB genome with a 96%.[7]

New skin tests: The WHO recommends three new antigen-primarily based pores and skin tests for TB contamination: Cy-Tb, C-TST, and Diaskintest. These exams carry out better than tuberculin pores and skin tests, specifically in phrases of specificity.[8]

Xpert MTB/RIF and Truenat: These cartridge-based totally nucleic acid amplification exams (NAAT) are the WHO's recommended preliminary diagnostic tests for suspected pulmonary TB. They can come across TB DNA and commonplace mutations associated with rifampicin resistance in approximately hours. Molecular beacons: These oligonucleotides emit light when a chemical reaction takes place. A new test makes use of molecular beacons to unexpectedly discover mutations associated with drug resistance.[9]

Computer-aided detection (CAD): This technology uses virtual chest radiography for TB screening.

Aerosol-capture technology: These technologies hit upon TB disorder.

Other latest improvements in TB research and innovation:

Other latest improvements in TB research and innovation include: Culture-unfastened, focused-sequencing solutions to test for drug resistance immediately from sputum specimens Broth micro dilution methods for drug-susceptibility checking out (DST) New IGRAs to test for TB contamination Technologies advocated by way of World Health Organization: Molecular detection of TB ailment and/or drug resistance Xpert MTB/RIF, MTB/RIF Ultra and MTB/XDR, Cepheid, USA GenoType® MTBDRplus, Hain Lifescience/Bruker, Germany Genoscholar® NTM+MDRTB II; Nipro, Japan GenoType® MTBDRsl, Hain Lifescience/Bruker, Germany TB LAMP, Eiken, Japan Truenat MTB, MTB Plus and MTB-RIF Dx assays, Molbio Diagnostics, India FluoroType MTB and MTBDR assays Hain Lifescience, Germany Abbott RealTime MTB and MTB RIF/INH on m2000sp and m2000rt structures, Abbott, USA BD Max MDR-TB, Becton Dickinson, USA Roche cobas® MTB and MTB-RIF/INH on Cobas 6800/880 systems, Roche Diagnostics, Switzerland Genoscholar PZA TB II, Nipro, Japan Interferon gamma release assays (IGRAs) for TB contamination detection T-SPOT. TB, Oxford Immunotec, UK QuantiFERON-TB Gold Plus (QFT-Plus), Qiagen, USA Wantai TB-IGRA, Wantai, China Mycobacterium tuberculosis antigen-primarily based pores and skin assessments Diaskintest, JSC Generium, Russian Federation Cy-Tb pores and skin check, Serum Institute of India, India C-TST, Anhui Zhifei Longcom Biopharmaceutical Co. Ltd, China Culture-based technologies Commercial liquid way of life, DST structures and fast speciation Microscopy Light and mild-emitting diode microscopy (analysis and remedy monitoring) Biomarker primarily based assays Determine TB-LAM Ag, Abbott, USA Computer-aided detection (CAD) for digital chest radiography CAD4TB v6, Delft Imaging, Netherlands Lunit INSIGHT CXR (TB set of rules v4.9.Zero), Lunit, Republic of Korea qXR v2, qure. Ai, India.[9]

CONCLUSION

Since past 5-6 decades the diagnosis of Tuberculosis shifted to more on genomic side. The ease of using the techniques, rapid results, less quantity of chemicals and more accurate results makes genomic based assays more useful over traditional assays. The correct and timely diagnosis is always helpful for treatment and cure of diseases. The World Health Organization authorized many new techniques in past decades for accurate diagnosis of Tuberculosis.

The study revealed the use of genomic and nanotechnology has potential for more accurate and rapid diagnosis in coming future for stop tuberculosis strategy.

Conflict of Intestate: No conflict of interests

Funding: Not required

Ethics Declaration: Not applicable

REFERENCES

1. World Health Organization's Consolidated guidelines on T.B. Diagnosis (2021) Rapid diagnostics for tuberculosis detection.
2. Global tuberculosis report 2020. WHO/HTM/TB/2020.22, Geneva: World Health Organization; 2020
3. (https://www.who.int/publications/i/item/9789240013131).
4. Implementing the End TB strategy: the essentials. Geneva: World Health Organization; 2015 (https://www.who.int/tb/publications/2015/end_tb_essential.pdf, accessed 26 May 2020).
5. American Red Cross. What is the nucleic acid test (NAT)?(https://www.sharecare.com/health/blood-basics/what-is-the-nucleic-acid-test-n-a-t)
6. Line probe assays for drug-resistant tuberculosis detection: interpretation and reporting guide for laboratory staff and clinicians. Geneva: Global Laboratory Initiative; 2018 (http://www.stoptb.org/wg/gli/assets/documents/LPA_test_web_ready.pdf, accessed 26 May 2020).
7. Report for WHO: non-inferiority evaluation of Nipro NTM+MDRTB and Hain GenoType MTBDRplus

8. V2 line probe assays. Geneva: Foundation for Innovative New Diagnostics; 2015 (http://www.finddx.org/wp-content/uploads/2016/04/LPA-report_noninferiority-study_oct2015.pdf, accessed 26 May2020).
9. Feasey NA, Banada PP, Howson W, Sloan DJ, Mdolo A, Boehme C *et al*. Evaluation of Xpert MTB/RIF for detection of tuberculosis from blood samples of HIV-infected adults confirms *Mycobacterium tuberculosis* bacteremia as an indicator of poor prognosis. J Clin Microbiol. 2013;51(7):2311–6(https://pubmed.ncbi.nlm.nih.gov/23678061/, accessed 26 May 2020).