

# RAPID MOLECULAR ASSAY FOR TUBERCULOSIS: COST AND CONTRIBUTIONS

---

## TESTE RÁPIDO MOLECULAR PARA TUBERCULOSE: CUSTO E CONTRIBUIÇÕES

---

## PRUEBA RÁPIDA MOLECULAR DE LA TUBERCULOSIS: COSTO Y CONTRIBUCIONES

Larissa Nicolau Lopes<sup>1</sup>  
Lilian Lessa Cardoso<sup>2</sup>  
Marcelle Saldanha da Silva<sup>3</sup>  
Edvaldo Tonin<sup>4</sup>  
Adriana Zilly<sup>5</sup>  
Reinaldo Antonio Silva-Sobrinho<sup>6</sup>

**How to cite this article:** Lopes LN, Cardoso LL, Silva MS, Tonin E, Zilly A, Silva-Sobrinho RA. Rapid molecular assay for tuberculosis: cost and contributions. Rev baiana enferm. 2020;34:e34803.

**Objective:** to identify the cost of the Gene Xpert MTB/Rif® technology and analyze its contribution to the rapid diagnosis of tuberculosis. **Method:** quantitative and retrospective study, carried out in the period from 2014 to 2016. Data search was performed on the Information System of Disease Notification and on the Laboratory Environment Manager. The data were analyzed based on the techniques of descriptive statistics through distribution of absolute and relative frequency. **Results:** 196 cases were studied, and the average time to perform the test for diagnosis of tuberculosis through Gene Xpert MTB/Rif® was two days, with a cost of 35.20R\$ per test performed. **Conclusion:** the costs of Gene Technology Xpert MTB/Rif® are relatively higher than that of sputum smear microscopy, but have great advantages in time to release the test result and higher sensitivity and specificity offered by the rapid molecular assay.

**Descriptors:** Tuberculosis. Finding. Tuberculosis, Pulmonary. Costs and Cost Analysis. Diagnostic Techniques, Respiratory System.

*Objetivo:* identificar o custo da tecnologia Gene Xpert MTB/Rif® e analisar sua contribuição para o diagnóstico rápido da tuberculose. *Método:* estudo quantitativo e retrospectivo realizado no período de 2014 a 2016. A busca de dados foi realizada no Sistema de Informação de Agravos de Notificação e no Gerenciador de Ambiente Laboratorial. Os dados foram analisados com base nas técnicas de estatística descritiva por meio da distribuição de frequência absoluta e relativa. *Resultados:* foram estudados 196 casos e a média de tempo para a realização do exame para diagnóstico da tuberculose por meio do Gene Xpert MTB/Rif® foi de dois dias, com custo de R\$ 35,20 por exame realizado. *Conclusão:* os custos da tecnologia Gene Xpert MTB/Rif® são relativamente superiores ao da baciloscopia

---

<sup>1</sup> Nursing Student. Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. lari.nicolau@hotmail.com. <https://orcid.org/0000-0001-6393-6779>.

<sup>2</sup> Nurse. Specialist in Intensive Care Unit. Professor at the Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. <https://orcid.org/0000-0001-9720-1041>.

<sup>3</sup> Nurse. Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. <https://orcid.org/0000-0002-9407-2659>.

<sup>4</sup> Pharmacist. Chemist. Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. <https://orcid.org/0000-0003-1210-4379>.

<sup>5</sup> Biologist. PhD in Biological Sciences. Professor at the Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. <https://orcid.org/0000-0002-8714-8205>.

<sup>6</sup> Nurse. PhD in Sciences. Professor at the Universidade Estadual do Oeste do Paraná. Foz do Iguaçu, Paraná, Brazil. <https://orcid.org/0000-0003-0421-4447>.

*de escarro, porém têm-se grandes vantagens quanto ao tempo para a liberação do resultado do exame e maior sensibilidade e especificidade oferecida pelo teste rápido molecular.*

*Descritores: Tuberculose. Diagnóstico. Tuberculose Pulmonar. Custos e Análise de Custo. Técnicas de Diagnóstico do Sistema Respiratório.*

*Objetivo: identificar el costo de la tecnología Gene Xpert MTB/Rif® y analizar su contribución para el diagnóstico rápido de la tuberculosis. Método: estudio cuantitativo, retrospectivo, realizado en el período de 2014 a 2016. Se realizó la búsqueda de datos en el Sistema de Información de Notificación de Enfermedades y en el Supervisor del Entorno de Laboratorio. Los datos fueron analizados con base en las técnicas de la estadística descriptiva por medio de distribución de frecuencias absolutas y relativas. Resultados: se estudiaron 196 casos y el promedio de tiempo para realizar el examen para el diagnóstico de la tuberculosis por medio del Gene Xpert MTB/Rif® fue de dos días, con un costo de 35.20R\$ por cada examen realizado. Conclusión: los costos de la tecnología Gene Xpert MTB/Rif® son relativamente más altos que los de la baciloscopia, pero tienen grandes ventajas en el tiempo para la publicación de los resultados del examen y mayor sensibilidad y especificidad ofrecidos por prueba rápida molecular.*

*Descriptorios: Tuberculosis. Hallazgo. Tuberculosis Pulmonar. Costos y Análisis de Costo. Técnicas de Diagnóstico del Sistema Respiratorio.*

## Introduction

Public health must prioritize goals that solve health problems, so that there is an improvement in the quality of life of citizens. In Brazil, tuberculosis (TB) continues to be a public health problem, since it is considered the fourth cause of deaths from infectious diseases, concentrated in vulnerable populations such as people living with the human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/Aids), deprived of freedom, in the streets, indigenous populations, people who live in unhealthy spaces and in poverty situation<sup>(1)</sup>. According to the 2018 epidemiological bulletin, in the year 2016, there were 4,426 deaths from TB and 69,569 people were diagnosed in 2017, with 8,074 reported in the Southern Region, in which, only in Paraná, there were 1,947 new cases during this period<sup>(2)</sup>.

In 2018, the coefficient of incidence of TB per group of 100,000 inhabitants in Brazil was 36.58, in the Southern Region, 29.74, and in the state of Paraná, 20.03; however, in Foz do Iguaçu (PR), the coefficient of incidence was higher, being more than twice as identified in Paraná (47.52)<sup>(3)</sup>. In addition, Foz do Iguaçu is a peculiar city, due to its location on the border with two countries, Paraguay and Argentina, still being the second city in Brazil that most receives international

tourists, conforming a high flow of people of different nationalities, and, consequently, with greater chance of transmission of contagious diseases due to the heterogeneity and diversity of the population.

Even being considered as an endemic disease, in the Brazilian territory, there is a concern of health professionals and researchers in the area in controlling the transmission of the disease, which occurs from person to person through the airways<sup>(4)</sup>.

TB can affect several organs and systems of the human body, but is more frequent in the lungs, being called pulmonary TB, caused by a bacillus known as *Mycobacterium tuberculosis* or Koch's bacillus, an opportunistic bacteria, which affects mainly people with vulnerable immune system, such as immunocompromised patients and even those in situations of social and health vulnerability<sup>(5)</sup>. The main symptom of pulmonary TB is a cough for more than three weeks, which may be accompanied by fever, night sweats, asthenia, lack of appetite and, consequently, weight loss<sup>(6)</sup>.

It is important to note that TB can be cured, the diagnosis and treatment are offered free of charge by the Unified Health System (SUS). The diagnosis of the disease requires the completion of laboratory tests, such as sputum smear

microscopy, considered a low-cost test. To perform sputum smear microscopy, the sputum (pulmonary secretions) must be collected from the patient, and, subsequently, there must be the count of bacilli found in a microscope slide with the smear of pulmonary secretions. This method of diagnosis must be carried out in two samples, that is, the first sample with the patient's biological material, collected when the person seeks the health service and the second sample, with the biological material collected the next morning<sup>(7)</sup>.

Currently, a technology called Gene Xpert MTB/Rif® can perform the test and release the result of the TB diagnosis in two hours, using only a sample of biological material and, in addition, check if the bacillus is resistant to the Rifampicin antibiotic, the main drug used in the treatment<sup>(6,8)</sup>. The platform Gene Xpert MTB/Rif® is a fast method that allows beginning the treatment as soon as possible, in addition to potentiating the decrease of the contagion by the Koch's bacillus<sup>(9)</sup>.

The Ministry of Health (MOH), through the National Tuberculosis Control Program, initiated the deployment of Gene Xpert MTB/Rif®, in 2013, in localities in Brazil with the highest incidences of the disease. The difficulties found in the adherence to the new technology were the public health laboratories that had no consistent structure or personnel trained for this new diagnostic methodology<sup>(9)</sup>.

The sputum smear microscopy, in case of pulmonary TB, has been cost-effective and widely used in developing countries, as is the case of Brazil, making it not only as a means of diagnosis, but also, a means to measure the monthly bacterial load, and control the treatment<sup>(10)</sup>.

Nevertheless, concerning the needs imposed by the emergence of multidrug-resistant TB, the delay in the diagnosis of the disease, the high rate of morbidity and mortality among vulnerable segments of the population and the factors that involve the guarantee of range of specificity and sensitivity of sputum smear microscopy, new diagnosis technologies have been formulated

and implemented, as is the case of the Gene Xpert MTB/Rif®<sup>(8-11)</sup>.

Given the above, this study aimed to identify the cost of the Gene Xpert MTB/Rif® technology and analyze its contribution to the rapid diagnosis of TB in Foz do Iguaçu, Paraná.

## Method

This is a descriptive, retrospective study conducted in the context of operational research. The data were obtained from a secondary source, relating to pulmonary TB cases diagnosed in the city of Foz do Iguaçu, Paraná, in the period from 2014 to 2016.

The consultation of the data was performed with the Tuberculosis Reference Service in the studied city, on the Information System of Disease Notification (SINAN) and on the laboratory Environment Manager (GAL).

During the research development, the city health network was organized in five health districts, composed of 30 Primary Health Care Units, 2 Emergency Care Units, 1 Reference Service for Tuberculosis and Leprosy Control, 1 outpatient service of the Specialized Care Service for Sexually Transmitted Infections (STIS)/AIDS, 3 hospitals and 1 Clinical Analysis City Laboratory. These services involve the diagnosis, treatment/follow-up and epidemiological surveillance in TB.

The study population consisted of patients with pulmonary TB, diagnosed with the traditional sputum smear microscopy and rapid molecular assay – Gene Xpert MTB/Rif® – in the period from 2014 to 2016, both provided by the UHS. There was exclusion of those with both diagnosis means in the SINAN notification form. During the studied period, as notifications on SINAN, 320 people had a diagnosis of pulmonary TB confirmed by sputum smear and/or Gene Xpert MTB/Rif®, however, only 196 patients were selected for the study, due to missing information on the date of sputum collection or release date of the result of the tests.

The data, according to the selected variables, were entered in a spreadsheet in Microsoft

Excel® and analyzed based on descriptive statistical techniques through the distribution of absolute and relative frequency.

To calculate the time to obtain the test result to confirm or discard TB, using the Gene Xpert MTB/Rif®, the arithmetic mean of days had to be calculated, from the date of sputum collection until the release of the test result, as recorded on GAL.

However, to find the average time (days) to obtain the test result by sputum smear microscopy technique, there was need to resort to the National Handbook of Laboratory Surveillance of Tuberculosis and other Mycobacteria from the Ministry of Health<sup>(12)</sup>, which indicates the maximum time to issue the result, 24h - one day (T), also considering the sample feasibility (SF) that is five through seven days, since the dates of sputum collection to perform the tests were not available on GAL and were incomplete on SINAN. Thus, the following formula was used: SF + T = X (7 days + 1 day = 8 days), by applying the calculation of the arithmetic mean, in which the sum of all values is divided by the number of elements added to find in how many days (mean) the result of the bacilloscopy is released .

$$\begin{aligned} &\text{Arithmetic mean: } \bar{X} \\ &\text{Number of elements: } n \\ &\bar{X} = \frac{(X_1 + X_2 + X_3 + \dots + X_n)}{n} \end{aligned}$$

After knowing the average time (days) that the patient waited for the test result by the sputum smear microscopy technique and by the Gene Xpert MTB/Rif® rapid molecular assay, there was the calculation, through the equation below, of the amount of people that the patient could potentially infect while awaiting confirmation of the positive result of TB in a year. Considering

the information from the Ministry of Health<sup>(10)</sup>, which signals that a patient with pulmonary TB can transmit the disease and infect an average of 10 through 15 people during one year, the researchers chose to use the maximum value (15 people/year).

$$X = \frac{\text{Total days of the year}}{\text{Amount of people that a sick person can infect per year}}$$

Thus, to calculate the amount of people who could potentially become infected with *Mycobacterium tuberculosis* during the wait for the confirmation of the test result, in case it was positive, the equation  $X = y.z$  was applied ( $y$  being the number of people that can become infected, and  $z$ , the number of days expected to receive the result of the diagnosis of TB).

Regarding the cost of the Gene Xpert MTB/Rif® molecular test and of the sputum smear microscopy, the reference for the survey of monetary values was the Technical Report: Economic studies of the incorporation of the Gene Xpert MTB/Rif® molecular test for the diagnosis of pulmonary tuberculosis in the Unified Health System<sup>(13)</sup>.

The study was approved by the Human Research Ethics Committee (REC), with Opinion n. 2.515.366.

## Results

The male population accounted for 74.5% of affected individuals with pulmonary TB, the age range of higher frequency was 20-39 years old, the white ethnicity had 60.2% of representativeness, and in relation to education, the majority reported having incomplete primary education (57.1%) (Table 1).

**Table 1** – Distribution of sociodemographic variables of people diagnosed with tuberculosis. Foz do Iguaçu, Paraná, Brazil – 2014-2016 (N=196) (continued)

Characteristics	n	%
<b>Sex</b>		
Male	146	74.5
Female	50	25.5

**Table 1** – Distribution of sociodemographic variables of people diagnosed with tuberculosis. Foz do Iguaçu, Paraná, Brazil – 2014-2016 (N=196) (conclusion)

Characteristics	n	%
<b>Age Range</b>		
01 - 19	18	9.2
20 - 39	95	48.5
40 - 59	67	34.2
60 - 79	13	6.6
80 - 99	3	1.5
<b>Ethnicity</b>		
White	118	60.2
Black	10	5.1
Yellow	2	1.0
<i>Pardo</i>	64	32.7
Indigenous	0	0.0
Ignored	2	1.0
<b>Education</b>		
Illiterate	8	4.1
Incomplete Primary Education	112	57.1
Complete Primary Education	17	8.7
Incomplete Secondary Education	18	9.2
Complete Secondary Education	16	8.2
Incomplete Higher Education	4	2.0
Complete Higher Education	1	0.5
Ignored/Not applicable/Inconclusive	20	10.2

Source: Created by the authors.

Table 2 shows that, in the year 2014, 64.8% of the patients had a diagnosis of TB by the sputum smear microscopy, being the Basic Health Units (BHU) the main sources of notification in this period (68%). Concerning the active search of cases among acquaintances

of TB patients examined, 85% were evaluated. The mean time to perform the test for the diagnosis was two days, when using the Gene Xpert MTB/Rif® rapid molecular assay, at a cost of 35.20 R\$ per assay performed.

**Table 2** – Operational data of patients diagnosed and notified with tuberculosis. Foz do Iguaçu, Paraná, Brazil – 2014-2016 (continued)

Variables	Frequency	%	Mean (days)	Monetary value (R\$)
<b>Type and year of Diagnosis</b>				
Sputum Smear Microscopy 2014	127	64.8	-	-
Gene Xpert MTB/Rif® 2015	39	19.9	-	-
Gene Xpert MTB/Rif® 2016	30	15.3	-	-
Total	196	100	-	-
<b>Reporting Institution</b>				
Basic Health Unit	134	68.0	-	-
Emergency Room	20	10.2	-	-
Hospital	39	19.8	-	-
Center of Medical Specialties	3	2.0	-	-
<b>Patients' acquaintances</b>				
Identified acquaintances	523	100	-	-
Examined acquaintances	443	85	-	-

**Table 2** – Operational data of patients diagnosed and notified with tuberculosis. Foz do Iguaçu, Paraná, Brazil – 2014-2016 (conclusion)

Variables	Frequency	%	Mean (days)	Monetary value (R\$)
<b>Mean waiting time for the Result</b>				
Sputum Smear Microscopy	-	-	4.5 <sup>a</sup>	-
Gene Xpert MTB/Rif®	-	-	2	-
<b>Unitary Cost of the diagnoses<sup>b</sup></b>				
Sputum Smear Microscopy	-	-	-	14.40
Gene Xpert MTB/Rif®	-	-	-	35.20

Source: Created by the authors.

Note: Conventional sign used:

- Numeric data equal to zero not resulting from rounding.

<sup>a</sup> The mean waiting time for the smear result was established based on data from the National Handbook of Laboratory Surveillance of Tuberculosis and other Mycobacteria from the Ministry of Health<sup>(12)</sup>.

<sup>b</sup> Based on the Technical Report: Economic studies of the incorporation of the Gene Xpert MTB/Rif® molecular assay for the diagnosis of pulmonary tuberculosis in the Unified Health System<sup>(13)</sup>.

The amount of people who could potentially become infected with *Mycobacterium tuberculosis* during the wait for the confirmation of the positive result of TB, next to a suspected case is 0.08 people when the test employed is the Gene Xpert MTB/Rif® assay and 0.18 people when the method is the sputum smear microscopy.

## Discussion

The knowledge of the population with higher likelihood of developing the disease allows targeting the prevention and care methods to the population in greater risk. The sociodemographic profile of the patients of Foz do Iguaçu is similar to some regions of the country, as in the state of Rio de Janeiro<sup>(14)</sup> and in Vale do Ribeira<sup>(15)</sup>.

The justification may be connected to the vulnerability of individuals regardless of geographic location, since, even in locations with high income profile and Human Development Index (HDI), there will be vulnerable groups, because one of the global causes of persistence of the occurrence of TB is social inequality that causes asymmetry in access to income, educational apparatuses, housing/society, safety and range of quality of life<sup>(16)</sup>.

One of the tricks to diagnose this disease is the sputum smear microscopy, a fast, simple and low-cost method to the UHS. Another quicker

method is the Gene Xpert MTB/Rif®, which, in about two hours, can release the result and, in addition to the diagnosis, identifies if there is resistance to Rifampicin, one of the antibiotics used in the treatment<sup>(17)</sup>.

The World Health Organization historically emphasizes the importance of search strategies that strengthen the access to prevention, diagnosis and treatment of TB, aiming to reduce the incidence and mortality from the disease<sup>(16)</sup>. Thus, the National Plan for the end of Tuberculosis comprises measures in this direction, so that, in the year 2013, the Molecular Rapid Assay for Tuberculosis (MRA-TB) was included in the UHS, formed by a Rapid Assay Network for TB, formed by 127 laboratories in 92 municipalities. Foz do Iguaçu is included as it meets the election criteria, one of which is being an international border city<sup>(18)</sup>.

Since then, the city of Foz do Iguaçu has been implementing the diagnosis of new cases through the MRA-TB. The frequency of cases diagnosed with this method is greater, but, due to lack of information on the date of entry of the application on the system and the result release, they could not be considered in this research.

An important way to diagnose symptomatic cases of pulmonary TB in the community should occur along the work of Community Health Workers (CHW), who have bonds with



the families and interact in the space (housing) where people live. Thus, the CHW, along with his/her team, linked to a BHU, has a primary role in the discovery of new cases<sup>(19)</sup>.

In this study, 32% of the new cases were diagnosed outside the BHU, even with the control of TB formally decentralized to Primary Health Care. A study carried out in Manaus showed that 0.20% of cases were reported in hospital institutions<sup>(20)</sup>. These numbers are important, because the existence of TB notifications in the hospital environment indicates a late diagnosis and a situation of urgency/emergency regarding the patient's health, that is, the time to seek the health system was longer and/or the BHU team could not perform an active search necessary to reach individuals<sup>(19)</sup>.

Another essential point to be discussed is the amount of acquaintances of a TB patient examined. This is an activity that needs to be performed by the BHU, vital for the diagnosis of new cases and fundamental to reduce the prevalence of the disease. This study evidenced that 85% of patients' acquaintances were examined, a positive result when compared to the percentage of the Brazilian capitals in 2017, in which the best percentage was in the cities of São Luís (MA) (77.5%) and in Brasília (DF) (66.3%)<sup>(2)</sup>.

In terms of the mean waiting time for the result of the TB diagnostic tests, when the technique applied was the sputum smear microscopy, it took 4.5 days on average for the issuance of the result, although, according to the Handbook of Recommendations for Tuberculosis Control in Brazil, the result of the bacilloscopy should be available within 24 h<sup>(10-12)</sup>. As noted, this did not occur in this study, and may have been triggered by several reasons, such as the high number of assays to be performed by the laboratory, the management to send the sample of biological material, and the return logistics for the result be delivered to the patient. These challenges can increase the mean time to obtain the diagnosis. The Gene Xpert MTB/Rif® can detect the bacterium in the sample in just 2 hours<sup>(18)</sup>, however, due to issues related to management, the result in Foz do Iguaçu took,

on average, two days to be available. In this way, the Gene Xpert MTB/Rif®, despite being a fast method, issues related to the logistics of transporting samples and providing the result can elevate and postpone the diagnosis with laboratory confirmation.

Knowing that an individual with pulmonary TB can transmit the bacillus to up to 15 people in one year<sup>(10)</sup>, the waiting period for the diagnosis may increase or decrease the incidence of transmission, depending on the method used to identify the bacterium.

Under this perspective, according to the time of issuance of the result (as shown in this study), the patient can infect 0.08 people (in 2 days) when the technique of identification of the *Mycobacterium tuberculosis* gene is the Gene Xpert MTB/Rif®; on the other hand, when identification is done by the sputum smear microscopy, the value rises to 0.18 persons (4.5 days). These values, when observed in isolation are small, but they have a wide spread when analyzing with the values of new cases in the country. In this sense, the need for only one sample of sputum and the automation of the Gene Xpert MTB/Rif® was the main variable that accelerated the availability of test results, reducing the chance of spreading the disease.

Another significant aspect is the cost of sputum smear microscopy (14.40 R\$) and the Gene Xpert MTB/Rif® (35.20 R\$). Nonetheless, the smear microscopy should be performed in two samples, i.e., twice<sup>(7)</sup>; thus, the final value of the test, when performed with sputum smear microscopy, is R\$ 28.80. In view of these results, one can say that the cost of sputum smear microscopy remains lower than the Gene Xpert MTB/Rif®, with a difference of R\$ 6.40. However, a study<sup>(21)</sup> states that the smear should reach 70% of sensitivity, and performing two sputum smear microscopies can reach 80%. On the other hand, the new technology has higher sensitivity (88%) to identify the TB-causing bacillus, which consequently decreases the chances of result error. Pregnant women and immunocompromised patients, such as HIV patients, have more difficulty to diagnose the

disease; however, according to studies, the Gene Xpert MTB/Rif® still has greater sensitivity<sup>(22)</sup>.

As published in the Brazilian Bulletin of Health Technology Assessment (BRATS), the sensitivity of tests in samples with positive results for sputum smear microscopy and bacterial culture is from 98% to 100%, but the test was able to detect up to 78% of negative cases (false-negative with sputum smear microscopy). If there are false-negative results in the sputum smear microscopy, this number may gradually increase, which would be avoided by the use of molecular assay. Regarding specificity, the results obtained with the Gene Xpert MTB/Rif® range from 90.9% to 100%, in relation to the culture<sup>(17)</sup>.

Therefore, even being R\$ 6.40 more expensive, the Gene Xpert MTB/Rif® has advantages in relation to the rapidity and specificity in obtaining the result, and additionally detects the presence of resistance to Rifampicin, information that provides the establishment of proper treatment to the patient. Thus, the faster the diagnosis of TB, the faster can be the healing, and the smaller is the risk of spreading the disease<sup>(23)</sup>.

The limitations of this research are linked to those inherent in the use of data from secondary basis. The direct influence on the results of the present study was the lack of data to identify the time for the analysis and release of the test result, when using the diagnosis technique of sputum smear microscopy.

## Conclusion

The rapid diagnosis is one of the solutions to reduce TB indices, since, after the test result and the treatment, the chain of transmission of the bacillus that causes the disease is interrupted. The new diagnostic technology presents a higher cost, for being a high-tech equipment, but its benefits ensure an accurate, safe and rapid diagnosis, which can bring great changes in assistance in TB. However, for this to occur, the Gene Xpert MTB/Rif® should be made available to the counties along with training for health professionals, allowing the operational change with impact on the health of the collectivity.

Besides the economical aspect, it is worth considering the importance of false-negative results in sputum tests for *Mycobacterium tuberculosis*, because, with the technology of Gene Xpert MTB/Rif®, this problem is drastically reduced. In the event of a false-negative, the contaminated patient becomes a source of transmission to the population, spreading the disease, until he/she is eventually diagnosed and treated, being a serious issue to be resolved by public health. The rapid diagnosis for TB collaborates to reducing the disease transmission and, in the long term, decreasing the prevalence and, therefore, reducing costs, because, with fewer people infected, there will be less people needing diagnosis and treatment.

Future studies should be carried out on the use of new technologies in the detection and treatment of TB, contributing to discussions on cost/effectiveness, aiming at the control of the disease.

## Collaborations:

1 – conception, design, analysis and interpretation of data: Larissa Nicolau Lopes and Reinaldo Antonio Silva-Sobrinho;

2 – writing of the article and relevant critical review of the intellectual content: Larissa Nicolau Lopes, Lilian Lessa Cardoso, Marcelle Saldanha da Silva, Edvaldo Tonin, Adriana Zilly and Reinaldo Antonio Silva-Sobrinho;

3 – final approval of the version to be published: Larissa Nicolau Lopes and Reinaldo Antonio Silva-Sobrinho.

## References

1. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Programa Nacional de Controle da Tuberculose [Internet]. Brasília (DF); 2018 [cited 2019 Oct 28]. Available from: <https://portal.arquivos2.saude.gov.br/images/pdf/2018/marco/19/APRES-PADRAO-JAN-2018-REDUZIDA.pdf>
2. Brasil. Ministério da Saúde. Implantação do Plano Nacional pelo Fim da Tuberculose como Problema de Saúde Pública no Brasil: primeiros passos rumo ao alcance das metas. Boletim Epidemiológico



- [Internet]. 2018 [cited 2019 Nov 5];49(11):1-18. Available from: <https://www.saude.gov.br/images/pdf/2018/marco/26/2018-009.pdf>
3. Brasil. Ministério da Saúde. Informações de saúde. Epidemiológicas e Morbidade (Tabwin) Brasília (DF); 2019 [cited 2020 Mar 18]. Available from: <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinannet/cnv/tubercpr.def>
  4. Pedro HSP, Nardi SMT, Finardi AJ, Moraes EB, Oliveira RS, Pereira MIF, et al. Cenário atual da tuberculose. *Hansen Int* [Internet]. 2014 [cited 2019 Oct 30];39(1):40-55. Available from: [http://www.ilsl.br/revista/detalhe\\_artigo.php?id=12229](http://www.ilsl.br/revista/detalhe_artigo.php?id=12229)
  5. Azevedo JAM, David LSMH, Marteleto MR. Redes sociais de usuários portadores de tuberculose: a influência das relações no enfrentamento da doença. *Saúde debate*. 2018 jun; 42(117):442-54. DOI: <https://doi.org/10.1590/0103-1104201811708>
  6. Kozakevich GV, Silva RM. Tuberculose: revisão de literatura. *Arq Catarin Med* [Internet]. 2015 [cited 2019 Nov 5];44(4):34-47. Available from: <http://www.acm.org.br/acm/seer/index.php/arquivos/article/view/46/42>
  7. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Guia de Vigilância em Saúde [Internet]. Brasília (DF); 2019 [cited 2019 Nov 3]. Available from: [http://bvsmms.saude.gov.br/bvs/publicacoes/guia\\_vigilancia\\_saude\\_3ed.pdf](http://bvsmms.saude.gov.br/bvs/publicacoes/guia_vigilancia_saude_3ed.pdf)
  8. Casela M, Cerqueira SMA, Casela TO, Pereira MA, Santos SQ, Pozo FAD, et al. Rapid molecular test for tuberculosis: impact of its routine use at a referral hospital. *J bras pneumol*. 2018 Apr;44(2):112-7. DOI: <http://dx.doi.org/10.1590/s1806-37562017000000201>
  9. Pinto MFT, Steffen R, Entringer A, Costa ACC, Trajman A. Impacto orçamentário da incorporação do GeneXpert MTB/RIF para o diagnóstico da tuberculose pulmonar na perspectiva do Sistema Único de Saúde, Brasil, 2013-2017. *Cad Saúde Pública*. 2017;33(9):e00214515. DOI: <http://dx.doi.org/10.1590/0102-311x00214515>
  10. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância das Doenças Transmissíveis. Manual de Recomendações para o Controle da Tuberculose no Brasil [Internet]. Brasília (DF); 2019 [cited 2019 Nov 3]. Available from: [http://bvsmms.saude.gov.br/bvs/publicacoes/manual\\_recomendacoes\\_controle\\_tuberculose\\_brasil\\_2\\_ed.pdf](http://bvsmms.saude.gov.br/bvs/publicacoes/manual_recomendacoes_controle_tuberculose_brasil_2_ed.pdf)
  11. Steingart KR, Schiller I, Horne DJ, Pai M, Boehme CC, Dendukuri N. Xpert® MTB/RIF assay for pulmonary tuberculosis and rifampicin resistance in adults. *Cochrane Database Syst Rev*. 2014;(1):CD009593. DOI: 10.1002/14651858.CD009593.pub3
  12. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Manual Nacional de Vigilância Laboratorial da Tuberculose e outras Micobactérias [Internet]. Brasília (DF); 2008 [cited 2019 Nov 3]. Available from: [http://bvsmms.saude.gov.br/bvs/publicacoes/manual\\_vigilancia\\_laboratorial\\_tuberculose.pdf](http://bvsmms.saude.gov.br/bvs/publicacoes/manual_vigilancia_laboratorial_tuberculose.pdf)
  13. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Programa Nacional de Controle da Tuberculose. Relatório técnico. Estudos econômicos da incorporação do teste molecular GeneXpert™ MTB/Rif para o diagnóstico de tuberculose pulmonar no Sistema Único de Saúde. Brasília; 2013 [cited 2019 Nov 4]. Available from: [http://www.fundacaoataulphodepaiva.com.br/2013/07/Relatorio-tecnico\\_25042013.pdf](http://www.fundacaoataulphodepaiva.com.br/2013/07/Relatorio-tecnico_25042013.pdf)
  14. Santos NJ, Sales MMC, Prado NT, Maciel LE. Fatores associados à cura no tratamento da tuberculose no estado do Rio de Janeiro, 2011-2014. *Epidemiol Serv Saúde*. 2018;27(3):e2017464. DOI: <https://doi.org/10.5123/S1679-49742018000300015>
  15. Pereira TLV, Pereira TI, Elias GP, Medeiro MCP, Souza AL. A Incidência de Tuberculose no Vale do Ribeira. *Rev Gestão em Foco* [Internet]. 2017 [cited 2019 Nov 4];9:90-102. Available from: [http://portal.unisepe.com.br/unifia/wp-content/uploads/sites/10001/2018/06/011\\_incidencia\\_tuberculose.pdf](http://portal.unisepe.com.br/unifia/wp-content/uploads/sites/10001/2018/06/011_incidencia_tuberculose.pdf)
  16. World Health Organization. Global tuberculosis control: surveillance, planning financing [Internet]. Geneva; 2006 [cited 2019 Nov 4]. Available from: [https://apps.who.int/s///10665/144567/9241563141\\_fj;jsessionid=B511E0D4213E200D68D69971F5C137CC?sequence=1](https://apps.who.int/s///10665/144567/9241563141_fj;jsessionid=B511E0D4213E200D68D69971F5C137CC?sequence=1)
  17. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. XPER® MTB/RIF no diagnóstico da tuberculose pulmonar. Boletim Brasileiro de Avaliação de Tecnologias em Saúde [Internet]. 2011 set [cited 2019 Nov 5];6(16). Available from: [http://bvsmms.saude.gov.br/bvs/periodicos/brats\\_16.pdf](http://bvsmms.saude.gov.br/bvs/periodicos/brats_16.pdf)

18. Lima MT, Belotti UCN, Nardi TMS, Pedro PSH. Teste rápido molecular GeneXpert MTB/RIF para diagnóstico da tuberculose. *Rev Pan-Amaz Saude.* 2017;8(2):65-76. DOI: <http://dx.doi.org/10.5123/s2176-62232017000200008>
19. Gaspar LMS. Conhecimento, atitudes e práticas dos agentes comunitários de saúde sobre tuberculose pulmonar no Município do Recife [dissertação] Recife (PE): Fundação Oswaldo Cruz; 2016 [cited 2019 Nov 5]. Available from: <https://www.arca.fiocruz.br/handle/icict/22915>
20. Farias SA. Perfil dos doentes de tuberculose no município de Manaus – Amazonas (2007) [dissertação]. São Paulo (SP): Universidade de São Paulo; 2010 [cited 2019 Nov 2]. Available from: <https://teses.usp.br/teses/disponiveis/22/22133/tde-14012011-155730/publico/ALTAIRSEABRADEFARIAS.pdf>
21. Pinto M, Entringer PA, Steffen R, Trajman A. Análise de custos de um teste de amplificação de ácido nucleico para o diagnóstico da tuberculose pulmonar sob a perspectiva do Sistema Único de Saúde. *J bras pneumol.* 2015;41(6):536-8. DOI: <https://doi.org/10.1590/s1806-37562015000004524>
22. Habib GZ, Dayyab MF, Sanda A, Tambuwal HS, Dalhat MM, Muhammad H, et al. Role of GeneXpert MTB/Rif Assay in Diagnosing Tuberculosis in Pregnancy and Puerperium. *Case Rep Infect Dis.* 2015(794109):1-5. DOI: 10.1155/2015/794109
23. Savioli MTG, Morrone N, Santoro I. Primary bacillary resistance in multidrug-resistant tuberculosis and predictive factors associated with cure at a referral center in São Paulo, Brazil. *J Bras Pneumol.* 2019;45(2):e20180075. DOI: 10.1590/1806-3713/e20180075

Received: December 9, 2019

Approved: March 25, 2020

Published: May 6, 2020



The *Revista Baiana de Enfermagem* use the Creative Commons license – Attribution -NonComercial 4.0 International. <https://creativecommons.org/licenses/by-nc/4.0/>

This article is an Open Access distributed under the terms of the Creative Commons (CC BY-NC). This license lets others remix, adapt and create upon your work to non-commercial use, and although new works must give its due credit and can not be for comercial purposes, the users do not have to license such derivative works under the same terms.