

# Risk Factors for Development of Destructive Pulmonary Tuberculosis and Possibilities for Predicting its Outcomes

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## Abstract

**Objective:** To determine the role of aggravating factors in the development of destructive pulmonary tuberculosis And to develop a model for predicting the probability of closure of decay cavities in patients with destructive forms of pulmonary tuberculosis.

A prospective study was conducted cohort study. Patients admitted to the hospital of the Grodno Regional Clinical Center "Phthisiology", as well as to the Republican Tuberculosis Hospital "Novoelnya" were examined. Depending on the prevailing aggravating factor, patients are divided into 10 groups. In addition, 2 more groups of patients with XDR MBT were formed. The results obtained indicate a significant negative impact of aggravating factors on the formation of destructive processes in the lungs. Patients with TB accompanied by diabetes mellitus, ADS, CNRD, patients arriving from places of detention and with the presence of several factors simultaneously should be considered more significant for this factor.

The results obtained indicate that the frequency of formation of destructive forms of tuberculosis in MDR-TB depends on a number of aggravating factors. The most significant in this regard: diabetes mellitus, several factors at the same time, ADS, patients arriving from places of detention, CNRD. Factors such as contact and gastrointestinal morbidity do not have a significant impact on the formation of destruction in the lungs in MDR-TB.

In the presence of XDR-TB, the highest frequency of destructive forms is observed (over 70%), reaching 76.0% in patients with XDR-TB in combination with ADS.

In order to develop a mathematical model for predicting the probability of closure of decay cavities in patients with destructive forms of pulmonary tuberculosis, studies were carried out on 105 patients with pulmonary tuberculosis, who had different patterns of destruction of lung tissue.

As a result of the study, it was established that prognostically important signs of the likelihood of closure of decay cavities are: clinical form, number of cavities, dependence on alcohol, and timing of abacillation.

When  $Z \geq -1.304$ , closure of the decay cavity is predicted within 6 months of chemotherapy. If  $Z < -1.304$  - the decay cavity does not close within a given period, the risk of developing gross morphological, sometimes irreversible changes increases

**Keywords:** Destructive Tuberculosis, Risk Factors for Tuberculosis, Multiple and Extensive Drug Resistance of Mycobacterium Tuberculosis, Long-Term Results, Prognosis

## Introduction

Currently, despite the generally favorable pathomorphosis of tuberculosis (TB), a number of factors remain that have a negative impact on the epidemiological situation, clinical manifestations and treatment results.

This is primarily the socio-economic situation in the region, as well as multiple and extensive drug resistance (MDR and XDR) *M. tuberculosis* (MBT). This also includes the influence of aggravating factors (high-risk factors). Their significance in the pathogenesis, clinical manifestations, outcomes, and effectiveness of disease therapy has been studied quite actively. More or less significant factors were established regarding the influence on the frequency of detection and the nature of the tuberculosis process, and the effectiveness of therapy.

However, in recent decades, the problem of the combination of MDR and XDR-TB with the presence of aggravating factors has arisen, which leads to aggravation of existing adverse effects. Many studies have been devoted to it, but the problem has not been studied enough, especially with regard to possible ways to correct emerging disorders [1, 2].

Among the most significant aggravating factors is, first of all, HIV infection. TB is an HIV-associated disease. The likelihood of developing TB among HIV-positive people is 30 times higher than that among HIV-negative people, reaching 5-10% within a year [3].

Among people who abuse alcohol, the rates are significantly higher than the average for the population - according to various sources, from 3 to 21 times or more. This contingent has a high level of concomitant pathology, personality traits change (deceit, duality of behavior, inability to complete a task) [4-6].

At the same time, not enough attention has been paid to studying the impact of alcohol dependence syndrome (ADS) in the presence of MDR-TB and XDR-TB, which in themselves, as is known, have a negative effect on the clinic, course and outcome of the tuberculosis process, and are one of the main problems of modern phthisiology [5].

To this day, the problem of the combination of TB and diabetes mellitus (DM) remains relevant, despite the fact that it has been studied for many years. It has been established that the incidence of TB in patients with diabetes exceeds the average by 3-14 times, with a tendency to increase [6].

Significant aggravating social factors include patients arriving from prison. The incidence of TB in penitentiary institutions is significantly higher than average. According to publications, its average rate in high-income countries is 237.6 per 100 thousand, and in low-income countries it is 1942 per 100 thousand. The incidence in prisons exceeds the average values of this indicator by 11-81 times, in the European region in 2017 – by 24 times [7, 8].

Chronic nonspecific respiratory diseases (CNRD), primarily COPD, are also considered as a significant aggravating factor. In general, in case of CNRD, tuberculosis is detected 3-4 times more often, its course is generally more severe, the development of destruction, diffuse pneumosclerosis, pulmonary blood flow

disorders, as well as the frequency of development of MDR/XDR-MBT increases [9].

Mental illnesses are also considered risk factors for the development of TB, which is largely associated with the conditions of long-term stay of patients in hospitals, the majority of them living in psychoneurological boarding schools, in crowded conditions, taking into account the characteristics of their behavior, which creates favorable conditions for the transmission of tuberculosis infection [10].

In patients with cancer, the use of aggressive methods of radiation and chemotherapy promotes the activation of tuberculous changes existing in the body [11].

Less significant factors include gastrointestinal diseases, contact, and motherhood.

In the presence of gastric and duodenal ulcers, the incidence of tuberculosis is 2-4 times more common. Treatment results are somewhat reduced, but generally satisfactory [1].

If there is contact with patients with MDR and XDR-TB, there is a high risk of primary detection of these particular forms of TB with consequent unfavorable treatment outcomes [1].

The problem of “tuberculosis and motherhood” requires separate consideration. Here we note that the effectiveness of tuberculosis treatment in pregnant and non-pregnant women is comparable, it is lower in the presence of MDR/XDR-TB [12].

The question of the role of aggravating factors in the formation of MDR and XDR-TB remains insufficiently studied. Attention is drawn to the presence of contact with bacteria shedding MDR and XDR MBT, antisocial behavior, the presence of ADS drug addiction, low adherence to treatment, breaks in treatment, the use of non-standard regimens, etc. [13, 1, 4].

Insufficient effectiveness of chemotherapy leads to the development of advanced destructive forms of pulmonary tuberculosis.

Thus, of the number of patients discharged from the hospital with preserved destruction of lung tissue, 73.3% had MDR MBT. During 3-4 years of observation, 56.7% experienced reactivation of the process, 35.6% developed fibrous-cavernous tuberculosis, and mortality from tuberculosis during this period was 16.7% [14].

Considering the above, the problem of early prediction of the outcome of destructive processes in the lung tissue and, accordingly, the choice of surgical or collapse therapy methods of treatment in order to achieve maximum effect is relevant.

## Purpose of the Study

To determine the role of aggravating factors in the development of destructive pulmonary tuberculosis and to develop a model for predicting the probability of closure of decay cavities in patients with destructive forms of pulmonary tuberculosis.

## Material and Methods

Prospective cohort study. Patients admitted to the hospital of the Grodno Regional Clinical Center (GOCC) “Phthisiology” (735

people), as well as to the Republican Tuberculosis Hospital “Novoelnya” (69 people) were examined. Clinical, radiological and laboratory examination in 2013-2018. was carried out upon admission of patients to the hospital, no later than the first 10 days. Traditional radiological methods were used, CT was performed when indicated. Identification of MBT was carried out by bacterioscopic and bacteriological methods ( BACTEC , culture on solid medium). Since 2014-2015 Molecular genetic

methods are widely used ( GeneXpert , LPA - test ). Depending on the prevailing aggravating factor, patients are divided into 10 groups. In addition, 2 more groups of patients with XDR MBT were formed. Persons in whom the activity of the tuberculosis process was not confirmed were excluded from the study.

Data on the names of aggravating factors and the number of patients examined are given in Table 1.

**Table 1: Name of aggravating factors and number of patients in the cohort.**

| No. | Name aggravating factor a                                  | Number examined patients |
|-----|------------------------------------------------------------|--------------------------|
| 1   | Without significant aggravating factors (comparison group) | 121                      |
| 2   | Diabetes mellitus (DM)                                     | 71                       |
| 3   | HIV infection                                              | 33                       |
| 4   | Alcohol dependence syndrome (ADS)                          | 189                      |
| 5   | Patients arriving from places of detention                 | 73                       |
| 6   | Chronic nonspecific respiratory diseases (CNRD)            | 50                       |
| 7   | Mental diseases                                            | 33                       |
| 8   | Gastrointestinal diseases, peptic ulcers, etc.             | 53                       |
| 9   | Contact in the past and present                            | 59                       |
| 10  | Some significant factors simultaneously                    | 122                      |

According to the literature and our own data, the most significant aggravating factors in relation to the impact on the incidence of TB, the severity of clinical manifestations, course and outcomes are recognized as: HIV infection, diabetes mellitus, ADS, patients arriving from places of detention, to a slightly lesser extent - chronic TB disease, then mental illness, Gastrointestinal diseases and contact. In addition, the patient took into account the presence of diseases of the liver, kidneys, nervous system (not mental), cardiovascular system, which in themselves can be quite severe, however, according to available data, a pronounced effect on the incidence, nature and course of tuberculosis the process is not provided. If a patient had two of the aggravating factors listed above, he was included in the group with a more significant factor, for example, contact and ADS - in the ADS cohort. For patients with the presence of several significant aggravating factors at the same time, a separate cohort was formed, which included 118 patients.

Patients whose aggravating factors were cancer, as well as women with pregnancy and the postpartum period were not included in the study due to the small number of patients in the groups, as well as persons who abuse alcohol but are not registered with a narcologist (domestic drunkenness), due to the lack of evidence-based criteria for the presence of such pathology. There was only medical history data, and the patient often hid alcohol abuse and some indirect indicators (absence of his family, work, etc.).

The situation with patients with the presence of XDR MBT, which in itself is a factor that aggravates the clinical manifestations and course of the tuberculosis process, is considered separately. The cohort of patients with XDR-TB included 180 people. A group of 75 patients with pulmonary TB who had a combination of ADS and XDR MBT was isolated from it.

In order to develop a mathematical model for predicting the probability of closure of decay cavities in patients with destruc-

tive forms of pulmonary tuberculosis, studies were carried out on 105 patients with pulmonary tuberculosis, who had different patterns of destruction of lung tissue. The patients were undergoing inpatient examination and treatment in Grodno Regional Clinical Center "Phthiology". The cohort of patients was divided into 2 groups: 1st – patients in whom, during chemotherapy, according to currently accepted standards, the decay cavity persisted for 6 months ( n = 72); 2 – patients in whom healing of the decay cavity was observed during chemotherapy ( n = 33).

Statistical processing of the results was carried out using the Statistica data processing package for Windows version 10.0 and Excel office application . Using Logistic Regression analysis, we determined the prognostic value of the indicators we studied. The result was considered statistically significant at  $p < 0.05$ .

### Results of the Study

Table 2 shows the frequency of formation of destructive pulmonary tuberculosis in patients with the presence of various aggravating factors and in their absence.

As can be seen from the table, even in group 1, i.e. in the absence of significant aggravating factors, there is a fairly high rate of presence of destructive forms of tuberculosis, amounting to 36.7%, and when excluding patients with the presence of XDR MBT, 34.0%. It should be noted that this work presents the entire spectrum of patients who were in hospitals, including those mainly for chronic forms of tuberculosis (“Novoelnya”), patients with XDR (“Oshmyany”), for compulsory treatment (“Boyary”), along with hospital Grodno Regional Clinical Dispensary, where newly diagnosed patients are admitted and those with treatment failure .

Analysis of the results obtained indicates that in all cohorts of patients, the frequency of decay cavities exceeds that in patients with pulmonary tuberculosis without the presence of significant risk factors, however, in some of them the excess

**Table 2: Development of destructive forms of MDR pulmonary tuberculosis in patients with the presence of various aggravating factors.**

| Name indicator                                       | Number of patients in groups and percentage |                               |                |                  |
|------------------------------------------------------|---------------------------------------------|-------------------------------|----------------|------------------|
|                                                      | Total                                       | with availability destruction | r 1 to 1 group | p 2 to group 1-A |
| Group 1 – without significant aggravating factors    | 121                                         | 44 - 36.4                     |                |                  |
| Group 1-A – patients with MDR-TB without XDR MBT     | 97                                          | 33 - 34.1                     |                |                  |
| 2nd group – HIV infection                            | 33                                          | 10 - 30.3                     | >0.05          | >0.05            |
| 3 group – contact                                    | 60                                          | 24 - 40.0                     | >0.05          | >0.05            |
| 4 group – gastrointestinal diseases                  | 53                                          | 26 - 49.1                     | >0.05          | >0.05            |
| 5 group – psychic diseases                           | 33                                          | 17 - 51.5                     | >0.05          | >0.05            |
| 6 group - CNRD                                       | 50                                          | 34 - 57.6                     | <0.05          | <0.05            |
| 7 group – patients arriving from places of detention | 73                                          | 36 - 49.3                     | >0.05          | =0.05            |
| 8 group – DM                                         | 71                                          | 44 - 62.0                     | <0.05          | <0.05            |
| 9 group – ADS                                        | 189                                         | 109-57.7                      | <0.05          | <0.05            |
| Group 10 – several significant factors               | 122                                         | 74 - 60.6                     | <0.05          | <0.05            |
| eleven group – XDR-TB                                | 189                                         | 140-74.1                      | <0.01          | <0.01            |
| Group 12 - XDR-TB+ADS                                | 75                                          | 57-76.0                       | <0.01          | <0.01            |

small and unreliable (  $p > 0.05$ ). Thus, among patients who had contact with tuberculosis patients in the past or present, it is only 4.3% (36.4-40.7%) and is statistically unreliable (  $p > 0.05$ ).

In patients with gastrointestinal diseases, the difference is more pronounced; the excess incidence of decay cavities is 12.9%, and in patients with mental illnesses – 15.1%. However, the difference remains non-significant (  $p > 0.05$ ). The difference is more pronounced in the cohort of patients arriving from places of detention. Here, the difference in the frequency of destructive forms is 12.7%, however, in patients with MDR-TB, when XDR is excluded, MBT is significant (  $p = 0.05$ ).

In all other examined groups, a clear and reliable increase in the frequency of formation of destructive forms of pulmonary tuberculosis was obtained in relation to the comparison group. The difference is 20.7% in patients with CNRD (  $p < 0.05$ ), ADS - 21.5% (  $p < 0.05$ ), diabetes mellitus - 25.0% (  $p < 0.05$ ), several factors simultaneously – 24.6% (  $p < 0.05$ ). They make up the absolute majority (77.5%) of the number of persons with aggravating factors (groups 2-9) - 77.5%.

A total of 30 patients were recruited into the HIV group. A peculiar course of the tuberculosis process takes place here. There was a tendency towards generalization and the appearance of extrapulmonary forms (tuberculous meningoencephalitis, bronchoadenitis). At the same time, decay cavities in the lungs formed in only 30%.

The nature of the destructive process, in particular the number of decay cavities in the patient, is also of certain importance. Thus, 2 or more cavities were found in patients without aggravating factors in 18.2% (1 group) of cases, from contact - in 29.9% (  $p > 0.05$ ), with gastrointestinal diseases – in 34.6% (  $p > 0.05$ ), with CNRD – in 41.1% (  $p > 0.05$ ), with diabetes – 41.9% (  $p < 0.05$ ), patients arriving from places of detention – 43.6% (  $p < 0.05$ ), with ADS – 44.3% (  $p < 0.05$ ), in the presence of several factors – 57.3% (  $p < 0.05$ ).

The influence of aggravating factors on the nature and severity of the tuberculosis process is evidenced to a certain extent by the ratio of the number of patients in each group with one decay cavity to that with two or more cavities. Thus, in persons with no significant risk factors it was 4.5, from contact – 2.4, with gastrointestinal diseases – 1.9, diabetes mellitus – 1.7, CHND – 1.4, ADS – 1.25, patients arriving from places of detention – 1.05, HIV infection – 0.8, several risk factors – 0.7.

An important factor that negatively affects the clinical picture and course of the tuberculosis process is XDR MBT. The literature provides limited data on their influence on the formation of XDR MBT [12]. Table 3 provides data on the frequency of development of XDR MBT in patients with the presence of various aggravating factors and in their absence.

**Table 3: Frequency of development of XDR MBT in MDR-MTB with the presence of various aggravating factors and in their absence.**

| Name cohorts patients                             | Number of patients in groups and percentage |                     |             |
|---------------------------------------------------|---------------------------------------------|---------------------|-------------|
|                                                   | MBT plus                                    | Availability of XDR | r s 1 group |
| Group 1 – without significant aggravating factors | 121                                         | 11 - 9.1            | -           |
| 2nd group –r diabetes                             | 71                                          | 25 - 35.2           | <0.01       |
| 3 group – HIV infection                           | thirty                                      | 5-16.7              | >0.05       |
| 4 group – contact                                 | 60                                          | 7-11.7              | >0.05       |



|                                                      |     |           |       |
|------------------------------------------------------|-----|-----------|-------|
| 5 group – gastrointestinal diseases                  | 51  | 3-5.9     | >0.05 |
| 6 group – mental diseases                            | 33  | 6-18.2    | >0.05 |
| 7 group – HNZOD                                      | 58  | 8-17.5    | >0.05 |
| 8 group – patients arriving from places of detention | 70  | 25-35.7   | <0.05 |
| 9 group – ADS                                        | 189 | 53-28.0   | <0.05 |
| Group 10 – several significant factors               | 122 | 43 - 35.2 | <0.05 |
| Total with the presence of aggravating factors       | 694 | 175-25.2  | <0.05 |
| Total                                                | 805 | 186-23.1  | <0.05 |

As can be seen from the table, the frequency of formation of XDR MBT in the presence of aggravating factors is generally 23.1% higher than that in patients without them (9.3%). XDR MBT is especially common in patients with diabetes mellitus (35.7%), patients arriving from places of detention (35.3%), several factors simultaneously (33.9), ADS (27.3%), the difference with group 1 is significant everywhere. At the same time, in patients with gastrointestinal disease (5.9%), from contact

(11.9%), chronic diarrhea (14.5%), the difference with group 1 is not significant ( $p < 0.05$ ).

These differences may largely depend on the tendency of TB to develop exacerbations, relapses and chronicity of the process under the influence of various aggravating factors.

Table 4 provides data on the level of newly diagnosed, re-treated and chronic processes in the examined patients by group.

**Table 4: Percentage of newly diagnosed, re-treated and chronic patients with and without various aggravating factors.**

| Name groups                                          | Percentage of the total number in the group |                    |         |
|------------------------------------------------------|---------------------------------------------|--------------------|---------|
|                                                      | Again identified                            | Repeatedly treated | Chronic |
| Group 1 – without risk factors                       | 57.9                                        | 47.1               | 2.5     |
| 2nd group –r diabetes                                | 37.1                                        | 62.9               | 14.3    |
| 3 group – HIV infection                              | 51.7                                        | 43.3               | 13.3    |
| 4 group – ADS                                        | 29.5                                        | 70.5               | 16.9    |
| 5 group – HNZOD                                      | 41.1                                        | 58.9               | 21.4    |
| 6 group – some factors                               | 28.0                                        | 72.0               | 25.4    |
| 7 group – patients arriving from places of detention | 29.6                                        | 70.4               | 14.1    |
| Group 8 – contact                                    | 52.5                                        | 47.5               | 5.1     |
| 9 group – gastrointestinal diseases                  | 52.8                                        | 41.5               | 5.7     |

The data presented in Tables 3 and 4 indicate that the largest percentage of XDR-TB cases occurs in patients where, due to the negative influence of aggravating factors, there is a high frequency of recurrent and chronic course of the tuberculosis process. Such factors include diabetes mellitus, patients arriving from places of detention, several factors simultaneously and ADS. XDR MBT is least common in patients with gastrointestinal diseases and without aggravating factors (5.9 and 9.1%), 6.0 and 3.8 times, respectively.

Of significant interest is the question of the influence of XDR-TB in general on the formation of destructive forms of pulmonary tuberculosis.

A prospective examination of 180 patients who were treated in the hospitals of the State Clinical Clinical Center "Phthisiology" and the hospital "Novoelnya" was carried out. Among them, men (86.1%) of working age predominated (85.0%). Of the clinical forms of tuberculosis, infiltrative - 46.1%, fibrous-cavernous - 38.9% predominated. Disseminated tuberculosis and caseous pneumonia were observed in 5.5 and 3.3% of cases, respectively. Limited forms of the disease were very rare - focal tuberculosis and tuberculoma, in 2.8 and 1.1% of cases, respectively. In 85% of patients, the process in the lungs was widespread, more than two segments. Only in 16.1% TB was detected for the first time,

while in 38.3% it became chronic. Of the aggravating factors, 64.4% of patients had alcohol abuse, 41.1% were registered for ADS, 16.1% came from an ITU, 16.1% had diabetes mellitus, 17.8% had several significant factors at the same time, 41.7% were disabled, only 15.5% worked.

As for the frequency of development of destructive forms of tuberculosis, it turned out to be higher than in other examined groups and amounted to 73.9%, in 133 patients out of 180. At the same time, 2 or more cavities occurred in 57.1%.

A prospective study was conducted on a cohort of patients with XDR-TB in combination with SZA from a total number of patients with XDR-TB, 75 people. Among them, 40% had fibrous-cavernous tuberculosis, 5.3% each had caseous pneumonia and disseminated tuberculosis, and only 33.3% had infiltrative tuberculosis. Of the limited forms, in one case (1.3%) - tuberculoma, a common process - in 86.7%. There were only 5.3% of newly diagnosed patients, and 41.3% with a chronic process. 5.3% were working, 60.0% had disabilities. The frequency of the presence of decay cavities turned out to be the highest of the examined groups, amounting to 76.0% (in 5 patients), two and to develop a predictive model for the likelihood of decay cavity closure, 51 variables were initially analyzed. The results of clinical, laboratory, and radiological studies were taken for analysis.

The logistic regression carried out allowed us to include the following variables in the model: gender, clinical form of tuberculosis, number of cavities, nature of destructive changes, prevalence of the tuberculosis process, nature of drug resistance, detection, ADS gastrointestinal diseases, diabetes, contact, presence of several risk factors simultaneously, timing of abacillation.

In practical terms, it is important to keep the set of variables to a minimum. Using selection procedures, it is necessary to identify the variables that are most significant in terms of prognosis. Using the stepwise regression method, we obtained a final set of variables - predictors of closure of decay cavities in patients with destructive forms of pulmonary TB (Table 5).

**Table 5: Predictors of preservation of decay cavities in patients with destructive pulmonary tuberculosis**

| Independent parameter       | Parameter regression equations (B) | R       | Attitude chances (OR) | 95% confidence interval (CI) |              |
|-----------------------------|------------------------------------|---------|-----------------------|------------------------------|--------------|
|                             |                                    |         |                       | lower border                 | upper border |
| Clinical form tuberculosis  | -4.907                             | 0.006   | 0.007                 | 0.000                        | 0.250        |
| Two cavities and more       | -3.682                             | 0.005   | 0.025                 | 0.002                        | 0.326        |
| ADS                         | -2.169                             | 0.009   | 0.114                 | 0.023                        | 0.580        |
| Abacillation up to 3 months | 0                                  | 0.019   | -                     | -                            | -            |
| Abacillation 3–4 months .   | 4.115                              | 0.008   | 0.016                 | 0.001                        | 0.348        |
| Abacillation 5–6 months .   | 5,189                              | 0.002   | 0.006                 | 0.000                        | 0.140        |
| Absence abacillation        | 25,249                             | 0, 0 09 | 0.000                 | 0.000                        | -            |
| Constant                    | 6,456                              | 0.000   | 636.293               | -                            | -            |

**Note – p – Wald Statistic**

Thus, the following variables were included in the model: clinical form (CF) of pulmonary TB, number of decay cavities (CD), presence of ADS, timing of abacillation (A). Based on the results obtained, a regression equation was constructed to calculate the prediction of the possible preservation of decay cavities against the background of chemotherapy:

$$Z_1 = 6.456 - 4.907 \cdot CF - 3.682 \cdot CD - 2.169 \cdot ADS - A, (3.1)$$

where: CF=0 for infiltrative pulmonary TB in the decay phase;

CF=1 for cavernous om;

CD=0 in the presence of 1 decay cavity; CD=1 in the presence of 2 cavities or more;

ADS – alcohol dependence syndrome (0 – no sign, 1 – present sign);

A=0 abacillation was obtained within 3 months; A=4.115 – 3-4 months; A=5.189 – 5-6 months; A=25.249 – in the absence of abacillation.

To determine the stability and effectiveness of the constructed model, the probability of preserving decay cavities, an assessment of its performance was carried out on an examination sample (n = 105). The effectiveness of treatment was assessed according to criteria generally accepted in phthisiology - the frequency of abacillation and closure of decay cavities (Tables 6 and 7).

**Table 6: Frequency and timing of abacillation in patients with destructive forms of pulmonary TB**

| Timing of abacillation | N   | %    |
|------------------------|-----|------|
| up to 3 months         | 16  | 15.3 |
| 3-4 months             | 36  | 34.3 |
| 5-6 months             | 64  | 61.0 |
| More than 6 months _   | 85  | 81   |
| Absence abacillation   | 20  | 19   |
| Total                  | 105 | 100  |

**Table 7: Closure of decay cavities in patients with destructive forms of pulmonary TB**

| Closing decay cavities | N   | %    |
|------------------------|-----|------|
| Closed                 | 33  | 32.7 |
| Not closed             | 72  | 67.3 |
| Total                  | 105 | 100  |

A comparison of the forecast results and the data obtained in the examination sample made it possible to calculate the sensitivity, specificity and predictive value of the model; for this purpose, a contingency table was used (Tables 8 and 9).

**Table 8: Contingency table for assessing the sensitivity, specificity and predictive value of the prediction model**

| Sign | Exodus                     |                            |
|------|----------------------------|----------------------------|
|      | Unfavorable                | favorable                  |
| Eat  | True Positive<br>a         | False positive result<br>b |
| No   | False negative result<br>c | Truly negative result<br>d |

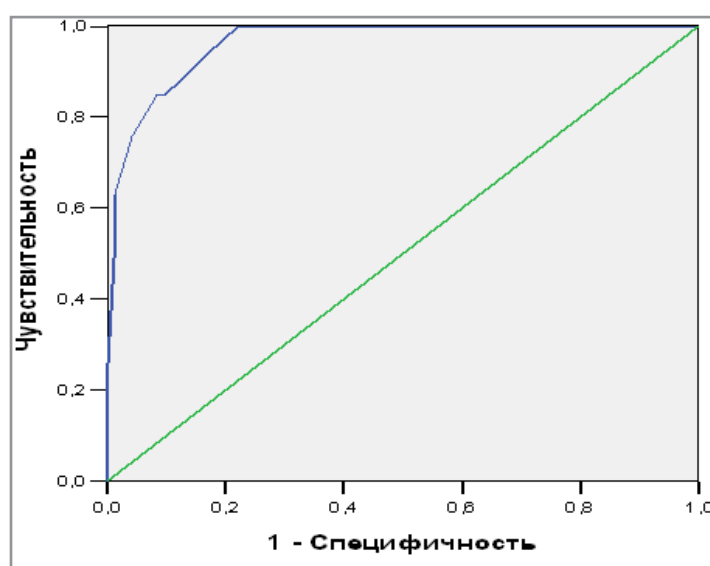
**Table 9: Contingency table for assessing the sensitivity, specificity and predictive value of the model for closing decay cavities in destructive forms of pulmonary TB**

| Group<br>( n=105 )    | Exodus                         |                                 |
|-----------------------|--------------------------------|---------------------------------|
|                       | cavity closed                  | cavity Not closed               |
| Cavity will close     | 32<br>( true positive result ) | 14<br>( false positive result ) |
| Cavity not will close | 1<br>( false negative result ) | 58<br>( true negative result )  |

Diagnostic sensitivity (DS) is the proportion of individuals with a positive result.  $PM = a / a + c$  (in %). Diagnostic specificity (DS) is the proportion of individuals with a negative result.  $DS = d / d + b$  (in %). Positive predictive value (PPV) is the probability of a positive result.  $PTSPR = a / a + b$ . Negative predictive value (NPV) is the probability of a negative result.  $PCOR = c / c + d$ .

The sensitivity of the method is 97.0%, specificity is 80.6%. The predictive value of a positive result is 69.6%, the predictive value of a negative result is 1.69%, diagnostic efficiency is 88.8%.

Using ROC analysis, an ROC curve was constructed and a separation point of -1.304 was determined (Figure 1). If  $Z \geq -1.304$ , we predict the closure of the decay cavity under chemotherapy conditions; if  $Z < -1.304$ , the decay cavity will not close.



**Figure 1: ROC curve of the obtained data for predicting the persistence of decay cavities in patients with destructive pulmonary tuberculosis during chemotherapy**

## Conclusions

The results obtained indicate a significant negative impact of aggravating factors on the formation of destructive processes in the lungs. Patients with TB accompanied by diabetes mellitus, ADS, CNRD, patients arriving from places of detention and with the presence of several factors simultaneously should be considered more significant for this factor.

Most aggravating factors had a negative impact not only on the frequency of development, but also on the nature of destructive processes in the lungs.

The results of a prospective study indicate that the frequency of formation of destructive forms of tuberculosis in MDR-TB depends on a number of aggravating factors. The most significant in this regard: diabetes mellitus, several factors at the same time, ADS, patients arriving from places of detention, CNRD.

The differences with the group of patients without aggravating factors are significant. Factors such as contact and gastrointestinal diseases do not have a significant impact on the formation of destruction in the lungs in MDR-TB.

The presence of XDR-TB in itself acts as an important aggravating factor that has a negative impact on the clinical manifestations of pulmonary tuberculosis, including the formation of its destructive forms. The highest frequency of destructive forms is noted (over 70%), reaching 76.0% in patients with XDR-TB in combination with ADS.

The results of predicting the possibility of preserving decay cavities against the background of chemotherapy allow the practitioner to use the main predictors of closure of decay cavities in each specific case. This will make it possible within a short time to predict the possibility of preservation of decay cavities with a sensitivity of 97%, specificity - 80.6% and to determine the tactics of treating patients, the advisability of using surgical or collapse therapy methods in the complex treatment of destructive pulmonary TB

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