

# Role of Sputum Smear in Predicting Culture Results in Pulmonary Tuberculosis

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## ABSTRACT

**Aim:** To determine the role of sputum smear in predicting the culture results in pulmonary tuberculosis.

**Study Design:** Cross sectional study

**Place and duration:** Rashid Latif Medical College and CMH, Lahore from Jan 2009 to Dec 2012

**Methods:** A total of 200 patients with positive sputum smear and sputum culture were selected by non probability convenient sampling but 20 patients lost to follow up and excluded from study. All the patients were given standard 04 drugs anti tuberculosis treatment in the intensive phase and Isoniazid (INH), Rifampicin and Myambutol in continuation phase. Sputum smear examination and culture was performed in every patient at end of second month of treatment.

**Results:** Out of 180 patients 129(71.7%) were male and 51(28.3%) were females. At two months 108(60%) patients were Sputum smear negative and 72(40%) were smear positive. Out of 108 smear negative patients 93(86.1%) were culture negative and 15(13.9%) were culture positive ( $p<0.005$ ). Out of smear positive patients 48(66.7%) were culture positive and 24(33.3%) were culture negative ( $p<0.005$ ). Sensitivity and specificity of 02 months sputum smear in predicting the culture conversion is 76.19% and 79.49% respectively.

**Conclusion:** The sensitivity, specificity, positive predictive value and negative predictive value of sputum smear examination in predicting the sputum culture result, are quite low. Sputum smear examination cannot be used as a substitute for sputum culture conversion at two months. However a negative sputum smear at two months is a strong predictor of culture negativity.

**Keywords:** Tuberculosis, smear conversion, culture conversion

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## INTRODUCTION

Pulmonary tuberculosis control involves the effective treatment and adequate measures to limit spread of infection. The most important is the achievement of treatment response as early as possible. Response to treatment in pulmonary TB patients is monitored by sputum smear examination and sputum culture. In the controlled trials using various drugs combinations the sputum culture conversion is used as surrogate marker of long term cure and predictor of relapse<sup>1-3</sup>. The efficacy of different regimen is tested by using this parameter. The culture of mycobacterium tuberculosis is time consuming and expensive. The facilities for culture are not available in most of the countries with high burden of tuberculosis especially the developing countries. An alternative to culture conversion testing is the smear conversion that is commonly used to assess the infectivity of patient, response to treatment and to document the cure of tuberculosis. It is easily performed, available in most

of the laboratories and very cost effective. The disadvantage is, not all smear positive patients are culture positive and not all smear negative patients are culture negative<sup>4-6</sup>. Studies have demonstrated the role of sputum smear in predicting the outcome of tuberculosis but the predictive role of sputum smear is less consistent than the predictive role of sputum culture. This relationship of sputum smear and sputum culture has not been studied well in the past. Very few studies are available that quantify the relation of sputum smear and sputum culture in terms of sensitivity, specificity and predictive value. The results are not consistent and some studies undervalue the role of sputum smear and others over rate its significance<sup>7</sup>. Quantification of role of sputum smear in predicting the culture conversion is of paramount importance. Once we are able to make out the predictive value of this relationship we can use the less expensive, readily available and easier to perform sputum smear examination instead of sputum culture for monitoring treatment response, treatment failure, infectivity and relapse in tuberculosis patients. In order to reinforce the existing data available on this subject we designed a study to find out the sensitivity, specificity and predictive value of sputum smear in predicting the result of sputum culture.

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## MATERIAL AND METHODS

This cross sectional study was conducted in the Rashid Latif Medical College and CMH, Lahore from Jan 2009 to Dec 2012. Patients presenting with symptoms suggestive of tuberculosis were screened by detailed history, physical examination, X-ray chest, blood complete picture, erythrocyte sedimentation rate (ESR), sputum smear examination and sputum culture. A total of 200 patients with positive sputum smear and sputum culture were selected by non probability convenient sampling. Patients who had smear negative, culture negative, previously treated for tuberculosis, primary drug resistance, uncontrolled diabetes mellitus, renal failure, hepatic failure, Human Immunodeficiency Virus infection and pregnancy were excluded from the study. All the patients were given standard 04 drugs anti tuberculosis treatment in the intensive phase and Isoniazid (INH), Rifampicin and Myambutol in continuation phase. All the patients were managed as outdoor patients and directly observed therapy (DOT) was not practiced. Sputum smear examination and cultures were performed in every patient at end of second month of treatment. BACTEC was used for culture. The data was collected on data collection form and SPSS 18 was used for statistical analysis. The sensitivity, specificity, positive predictive and negative predictive value of sputum smear was calculated. Chi square was used to compare proportions and T test was used to compare means. P value <0.05 was considered significant.

## RESULTS

A total of 200 patients were included in the study but 20 patients lost to follow up and excluded from study. Out of remaining 180 patients 129(71.7%) were male and 51(28.3%) were females. At two months 108(60%) patients were Sputum smear negative and 72(40%) were smear positive. Out of 108 smear negative patients 93(86.1%) were culture negative and 15(13.9%) were culture positive ( $p<0.005$ ). Out of 72 smear positive patients 48(66.7%) were culture positive and 24(33.3%) were culture negative ( $p<0.005$ ). The sensitivity specificity, positive predictive value and negative predictive value of sputum smear in predicting the culture results are shown in table 1. Treatment failure was observed in 33(18.4%). None of the patients in 02 month smear negative group was treatment failure. In the treatment failure group culture reports revealed 24 (sensitive to first line drugs), 3 (resistant to INH),3 (resistant to drugs other than INH and Rifampicin) and 3 (MDR cases).

Table 1: Predictive value of sputum smear in predicting culture results

Sensitivity	76.19%	95% CI: 63.79%- 86.01%
Specificity	79.49%	95% CI: 71.03% to 86.39%
+ve predictive value	66.67%	95% CI: 54.57% to 77.34%
-ve predictive value	86.11%	95% CI: 78.13%- 92.01 %

## DISCUSSION

In our study the rate of sputum smear conversion is 60%, the sputum culture conversion rate is 86.1% in smear negative, 33.3% in smear positive and over all culture conversion rate is 65%. Rate of sputum smear and culture conversion at two month has been reported to vary from 50.4% to 98.6% in various studies. In 2012 Viser et al. conducted a study in south Africa on sputum smear and culture positive tuberculosis patients and reported a 02 month culture conversion rate of 50.4% but 89% of his patients were having cavitatory tuberculosis and this factor alone strongly affects the culture conversion rate at two months<sup>8</sup>. Tiwari et al. conducted a study on smear positive tuberculosis in India and reported smear conversion rate of 57.9% among the High Positive smear and 71.6% in the Low positive smear patients. In this study the DOT was carried out and in our study we did not follow the DOT. The DOT therapy improves compliance and is a powerful factor that affect the outcome and culture conversion rate<sup>9</sup>. Banu et al. in 2007 studied the smear conversion and culture conversion in non diabetic, diabetic and HIV positive cases. He reported the smear conversion of (58, 61, and 62%) and culture conversion (86, 88 and 92%) in pulmonary tuberculosis alone, tuberculosis in type II diabetes and tuberculosis in HIV positive respectively. The study concluded that the sputum smear or culture conversion was dependent on age more than 45 years, higher pretreatment smear and extent of the disease<sup>10</sup>. The results of this study are consistent with our study. Felix et al. in 2013 reported a smear conversion rate of 80% and he concluded that initial higher smear grade ,HIV infection and non adherence to treatment was associated with non conversion<sup>11</sup>. In 2012 Caetano et al, observed a smear conversion rate of 74.6% and culture conversion rate of 72.8%. Age $\geq$ 50 years , male gender and higher smear grade were significantly associated with persistent smear positivity after 2 months of treatment and bilateral radiological involvement was associated with persistent culture positivity<sup>12</sup>. Rieder in 1996 reported 75% culture conversion rate, with a range from 61.7% to 90.9% in patients with initially strongly- and weakly-positive smears, respectively. He concluded that smear positivity at two months strongly predicted the culture results<sup>13</sup>. Bawri et al. in 2008 reported 84% smear conversion rate, slightly higher rate of smear conversion than our study but in this study the short

course DOTS regimen was used and DOTS is known factor to improve the compliance and ultimately the outcome in pulmonary tuberculosis<sup>14</sup>. Khalid in 2013 reported a 95% sputum smear conversion in his study but the study did not compare the culture results<sup>15</sup>. Mbazi et al in 2010 observed 98.6% and 97.0% 2 month sputum conversion rate and culture conversion rate of 98.6% and 97% in HIV positive and HIV negative patients respectively<sup>16</sup>. The high success rate of smear and culture conversion in this study could be attributed to DOTS. Factors that affect sputum smear conversion include old age, male sex, smoking, thrombocytosis, sputum collection techniques, base line smear grade extent of disease, drug compliance and drug resistance. The presence of diabetes mellitus, extensive or cavitary disease, high pretreatment smear grade and a past history of tuberculosis are factors influencing both sputum smear and culture conversion time in pulmonary TB<sup>17,18</sup>.

Our study has shown that sensitivity and specificity of 02 months sputum smear in predicting the culture conversion is 76.19% and 79.49%, respectively. Positive and negative predictive value of sputum smear is 66.67% and 86.11%, respectively. The sensitivity, specificity and positive predictive value are quite low however the negative predictive value of sputum smear is quite reasonable but not significantly high. Atypical mycobacterium, inefficient laboratory techniques commonly yield false positive smears<sup>6</sup>. The results of our study are consistent with other studies. In 2007 a study conducted by Su W, revealed that the sensitivity and specificity of 2-month sputum smears in predicting 2-month culture conversion were 64.3% and 81.6%, respectively<sup>3</sup>. In our study we could not implement DOT and poor compliance may be the reason of 24(33.3%) treatment failures despite the fact that isolate was sensitive to all first line drugs.

## CONCLUSION

The sensitivity, specificity, positive predictive value and negative predictive value of sputum smear examination in predicting the sputum culture result, are quite low. Sputum smear examination cannot be used as a substitute for sputum culture conversion at two months.

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