Evaluation of Pulmonary Tuberculosis Case Detection in Huejutla, Hidalgo According to the Synthetic Case Location Indicator (ISILOC)

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Received: June 09, 2020; Published: June 27, 2020

Abstract

Introduction: Pulmonary tuberculosis (PTB) is a health emergency. The low detection of cases of PTB has caused its spread; therefore, finding cases is essential to neutralize transmission. The Synthetic Case Location Indicator (ISILOC) contributes to effective and efficient detection.

Methods: From February to November 2018, participatory action research (PAR) was carried out. A baseline measure of the ISILOC was made and demographic data were collected: age, gender, years in the program and profession. Three focus groups were organized with personnel from the Mycobacteriosis program. Qualitative information was obtained following three sequential stages.

Results: A total of 40 physicians and nurses were included. The largest age group was 31 to 40 years (50%), 75% were women, 43% had more than 5 years in the program and 30% were doctors. The baseline measure of the ISILOC, 0.33, was deficient. In the group, 48% thought the program performance was poor. More than two-thirds of the participants considered that the low performance was due to deficiencies in detection. An action plan of three categories was made: Improvement of case detection, health personnel training and health education and dissemination in medical units. A second measurement of the indicator was a result of 0.70, very good.

Conclusion: The ISILOC methodology was effective, improving performance in the Mycobacteriosis program; its application has continued to date with a very good performance assessment.

Keywords: Indicators; Detection; Pulmonary Tuberculosis; Health Strategies; Health Program Performance

Introduction

The oldest evidence of human pulmonary tuberculosis (PTB) dates to half a million years ago and corresponds to Homo erectus, whose fossils were found in Turkey [1]. However, PTB is not a disease of the past. It is currently calculated that one-third of the world population is infected and more than 1.5 million people die annually because of this disease. The World Health Organization (WHO) considers it a health emergency. It is estimated that every year approximately 10 million new cases appear, which is paradoxical in essentially preventable and curable diseases [2]. The world program of the WHO has as its goal the detection of 70% of cases of bacilliferous TB and the cure of 85% of cases [3]. The principal weapon to achieve this is rapid detection and cure of infectious cases [3,4]. PTB is transmitted by contact with individuals who have active PTB [5]. It is known that the perpetuation of PTB depends on the number of individuals who excrete bacilli in the community, the time that they continue excreting them, and the number and intensity of effective contact with susceptible people in the community [4].

Low detection of PTB cases is a problem that advances its spread [6]; therefore, carrying out an appropriate case-finding process is an essential strategy for its control and elimination. Periodic and continuous assessment is important to maintain or increase the effectiveness and quality of control programs [7].

Despite this, several authors have documented a sub-diagnosis of PTB cases, a situation that burdens control and its eventual eradication. In a study carried out in Chiapas with 221 patients with chronic cough who came for medical attention, a positive PTB diagnosis was found in 19.9%. Six were first-time appointments and 38 were subsequent; of these, two had already been diagnosed by bacilloscopy. In this study, the authors concluded that there was a sub-registry of 9% of PTB [8].

In a similar study [9] the authors documented 56% PTB cases in coughing patients who came for non-respiratory symptoms.

A third study [10] analyzed 590 patients from 32 rural communities in two medical units, one primary care, and one secondary care. In this work, a total of 66% PTB cases were detected in the hospital. Regarding the sensitivity of bacilloscopy, in primary care, it was less than 50% and 60% in the hospital. In a study carried out in Hidalgo, this parameter was 30% [11].

Given this scenario, it is necessary to reinforce the detection and control of PTB in primary care. Raising awareness and providing health education to the general population would increase the demand for attention due to symptoms, as well as reduce the time between the start of coughing and the search for attention [12].

First of all, the detection process for PTB cases should be effective for control and elimination. The location (detection) of PTB cases is the fundamental activity of the project; its purpose is to rapidly find the largest number of ill individuals that comprise the main source of infection; that is, cases with a positive bacilloscopy. The detection (location) of cases implies a process with successively linked activities that are aimed at finding TB patients and adequately treating them. The goal is to neutralize real and potential transmission of \textit{M. tuberculosis} to avoid new TB cases and unnecessary deaths.

In this sense, Armas-Pérez., \textit{et al}. [13] have proposed a synthetic indicator to monitor and assess the quality of PTB case detection from PTB surveillance system data: the Synthetic Case Location Indicator (ISILOC) of pulmonary tuberculosis. This indicator responds to the need for a valid, reliable, feasible, simple, and accessible technical procedure in different local contexts that can also reveal, from a quantitative and qualitative point of view, the achievements and progress of case detection as an essential process of control strategies [14-16]. A weighing of values that result from basic arithmetic operations leads to the ISILOC score.

It is well known that the cornerstone of a PTB control program anywhere in the world is the opportune detection of cases (bacilli positive). The reasons for the sub-registry of PTB cases reported by different studies are diverse. Therefore, the idea of using a Synthetic Case Location Indicator (ISILOC) becomes a viable, effective, reliable and very low-cost proposal. Likewise, with better case detection, the control program improves and ensures cures.

After the application of the Synthetic Indicator, health personnel training should be carried out to improve epidemiological surveillance information to contribute to the correct location of cases and diagnostic opportunities in PTB [17,18]. It is not enough to estimate a case detection ratio if the delay in the processes of diagnosis, registration, and case notification is not considered [9].

\textbf{Aim of the Study}

The aim of this research was to assess the performance of the Mycobacteriosis program by detecting cases with the ISILOC in the Huasteca region of Hidalgo, Mexico.
Evaluation of Pulmonary Tuberculosis Case Detection in Huejutla, Hidalgo According to the Synthetic Case Location Indicator (ISILOC)

Methods

This was participatory action research (PAR) [19] with a mixed quantitative and qualitative design performed from February to November 2018. Health administrators and personnel from five (of seven) medical units affiliated with the Huejutla de Reyes, Hidalgo Health Jurisdiction, and users from the medical units, participated.

The quantitative component was the calculation of the ISILOC, using the following equation:

\[ \text{ISILOC} = \frac{(A + B) \times (G \times H)}{8} \]

Where:

- **A** = The proportion of individuals with respiratory symptoms >14 years (RS+14) detected.
- **B** = The proportion of first baciloscopies performed in the SR+14.
- **G** = Mean delay time between the first symptoms and the first consultation (days).
- **H** = Mean delay time between confirmation of the diagnosis and control of the index case (contact investigation).

8.- The value 8 is a score constant that expresses the sum of the maximum values of A and B.

<table>
<thead>
<tr>
<th>Component</th>
<th>Score</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and B</td>
<td>≥ 9.9</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.8 - 0.89</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0.7 - 0.79</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.6 - 0.69</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≤ 0.59</td>
<td>0</td>
</tr>
<tr>
<td>G</td>
<td>&lt;20</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>20 - 29</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>30 - 39</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>40 - 49</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>50 - 59</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>60 - 69</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>70 - 79</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>80 - 89</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>90 - 99</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>100 - 110</td>
<td>0.1</td>
</tr>
<tr>
<td>H</td>
<td>≤ 2 days</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3 - 4</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>5 - 7</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>8 - 9</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>10 - 12</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>13 - 15</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>16 - 18</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>19 - 21</td>
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<td>22 - 25</td>
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<tr>
<td></td>
<td>26 - 30</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>&gt;30</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Citation: Ocampo-Torres Moses, et al.*Evaluation of Pulmonary Tuberculosis Case Detection in Huejutla, Hidalgo According to the Synthetic Case Location Indicator (ISILOC).* EC Pulmonology and Respiratory Medicine 9.7 (2020): 111-120.
The ISILOC produces values between 0 and 1. The results are valued according to a nominal qualitative scale. The values considered for each indicator are the following; therefore, the final performance evaluation of the synthetic indicator is:

- 0.9 - 1 = Excellent
- 0.7 - 0.89 = Very good
- 0.4 - 0.69 = Acceptable
- 0.1 - 0.39 = Deficient
- 0 = Poor.

The following demographic data were obtained from the participants: age, gender, years in the program and profession.

For the case detection process, the ISILOC integrates at least four components: 1. Group selection and individuals at risk of presenting PTB; 2. Perception and risk behaviors of the population; 3. Diagnosis and 4. Registration and notification.

The interpretation of the indicators used for construction of the ISILOC is: the proportion of individuals with respiratory symptoms detected reveals the effectiveness in the identification of subjects at risk of suffering PTB; the proportion of smears performed on symptomatic patients shows the scope of the diagnosis; the delay time from the beginning of symptoms of PTB cases until their first consultation in the medical unit is an expression of education, risk perception, and awareness that the community has about the disease; and the delay between the date of diagnosis and the date of carrying out the epidemiological investigation of the case and its contacts is a reflection of the effectiveness of notification and registration.

The qualitative research component was obtained from the discussions directed and presented in the three focal groups (FG) that were formed in the following way: GF1: State directors of the Mycobacteriosis program (9 people); GF2: Jurisdictional administrators (3 people) and GF3: Operational staff of the Jurisdictional Mycobacteriosis program (28 people), for a total of 40 service providers. Data were collected and analyzed sequentially in three stages:

- **Stage 1 diagnosis:** Using guided group discussions, know the opinion of the participants regarding the performance of the PTB control program, identifying the problems that impede better performance and detecting the needs of health personnel and users of medical units.

- **Stage 2 intervention:** With the same qualitative methodology of stage 1, in this stage, the participants agreed, in a consensual manner and through participative research action workshops, the actions to be followed to improve case detection, staff training, and health education of the users of medical units. With the information collected, in this stage, an action plan was designed with the contribution of all the participants for execution in the communities of the region.

- **Stage 3 implementation:** A second ISILOC measure was made and, according to the evaluation of the results, the model was replicated in the other state jurisdictions. Likewise, a report was prepared with the contributions and ideas of the group for state health authorities. In this study, four ISILOC measurements were made: the first, baseline, at the beginning of the project, the second at the end to evaluate performance changes (before and after), the third, four months after the end of the project, and the fourth, six months later. The latter two were done to assess the Hawthorne effect.
All the information was captured in a database in Excel® version 2016. Quantitative data were analyzed by calculating simple frequencies and proportions, as well as an equation to assess ISILOC and its changes, measuring the indicator before and after the discussion workshops. Qualitative data were analyzed using the discourse analysis technique.

Results

During the study period, a total of 40 health service providers from seven primary care health centers in the state of Hidalgo, who integrated three focus groups according to their level of responsibility (state, regional and local) and 780 health system users participated.

In the quantitative component, the baseline measurement of the ISILOC had a score of 0.33, which represents poor performance.

In relation to demographic variables, the age distribution was <30 years, 6 (15%); 31 to 40 years, 20 (50%) and >40 years, 14 (35%). Gender was male 10 (25%) and female 30 (75%). The proportional distribution according to years in the Mycobacteriosis program was <1 year, 8 (19%); 1 to 5 years, 15 (38%) and >5 years, 17 (43%). Of the group, 30% were physicians and 70% nursing personnel.

Regarding the qualitative component developed in the focus group workshops, the opinions on program performance were grouped into five categories (Figure 1). Due to its high proportion, the opinion that the program was poor stood out with 48%. It is important to point out that opinion varied according to the level of responsibility; however, the three focus groups agreed to evaluate it as poor (50%, 53% and 47% respectively). More than two-thirds of the participants agreed that the main reason for this performance was related to deficiencies in case detection, listing at least nine causes for low performance (Table 1).

![Figure 1: Opinion of performance in the Mycobacteriosis program.](image-url)
Also, with the participation of the three focus groups, an action plan was made for execution in the medical units. Forty-eight actions were issued that were grouped into three categories: Procedure correction, training of health personnel from the medical units of the Health Jurisdiction (doctors and nurses) and dissemination and health education in PTB for general population (Table 2), using mass media: radio and television.

<table>
<thead>
<tr>
<th>Causes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of health personnel training</td>
<td>24</td>
</tr>
<tr>
<td>Deficient sampling</td>
<td>17</td>
</tr>
<tr>
<td>Deficient procedure standard</td>
<td>15</td>
</tr>
<tr>
<td>Socials determinants</td>
<td>13</td>
</tr>
<tr>
<td>Lack of health education</td>
<td>8</td>
</tr>
<tr>
<td>Delay in results delivery</td>
<td>7</td>
</tr>
<tr>
<td>Lack of supervision</td>
<td>7</td>
</tr>
<tr>
<td>Lack of resources</td>
<td>5</td>
</tr>
<tr>
<td>Lack of a local standard program</td>
<td>4</td>
</tr>
</tbody>
</table>

*Table 1: Causes of low performance in the Mycobacteriosis program.*

<table>
<thead>
<tr>
<th>Action Plan</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure correction</td>
<td>1 weeks</td>
</tr>
<tr>
<td>Health personnel training</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Population training</td>
<td>10 weeks</td>
</tr>
</tbody>
</table>

*Table 2: Action Plan with the opinions of the participants of the three Focus Groups.*

**Procedure correction**

Roundtables were formed to analyze the current procedure, from patient reception in the medical unit to delivery of the smear result by the laboratory to the health personnel of the medical unit. The process that previously took up to 60 days, with the procedure correction, was reduced to less than one week.

The personnel training model was theoretical and practical, using the presentation technique, guided discussion, and workshops, in which case detection and correct sampling of pulmonary secretions were emphasized. This procedure, like the previous one, was not standardized; therefore, in the workshops of the focus groups, the medical and nursing staff was trained regarding correct fixation of the patient sample, precise labeling, and proper transportation to the laboratory.

Population health education and dissemination was carried out by the health personnel of the medical units, who organized various health promotion activities with the participation of users; namely, planning together with the users the promotional activities in the medical unit, in the streets, and in public places of the communities in order to inform and raise public awareness about the importance of going to the medical unit as soon as possible as soon as the first symptoms begin. Also, to have a larger scope, two massive communication media were used (radio and TV), where in addition to disseminating health education messages, interviews related to the topic of PTB were transmitted to health professionals.
After concluding the workshops, training, and action plan, a second measurement of the indicator was made, obtaining a score of 0.70, which is equivalent to very good (Figure 2). However, because of the possibility of a Hawthorne effect, a third measurement of the ISILOC was made three months after the second with a score of 0.80, staying within the range of very good (Figure 2).

**Figure 2:** Evaluation of the performance of the Mycobacteriosis program with the ISILOC indicator. Four moments.

*: To measure the Hawthorne effect: Third, at 4 months and fourth, at 8 months.

**Discussion and Conclusion**

According to the WHO Global TB Programme, national control programs of this chronic infectious disease must have as a detection goal 70% of bacilliferous TB cases and a cure rate of these cases of 85% [3]. The principal weapon to achieve this is rapid detection and cure of infectious cases [3,4].

Since this is the strategic key for the location of suspicious cases and starting treatment, rapid detection of cases should be as efficient and effective as possible. In this sense, the application of the ISILOC was effective in increasing the detection of cases as was demonstrated in 2018 by Águila-Rodríguez., et al. [20] in a study that evaluated the quality of the Prevention and Control Program in Cuba that documented the effectiveness of applying the ISILOC. Like them and due to the actions carried out consensually with the health services providers, the authorities and the users of the state health system, we were also able to improve case detection by applying the ISILOC methodology.

As shown by Picketts [21] in a study conducted in Chile in 2012, the need to control the transmission of PTB in the population requires the detection of suspicious cases. The 1994 to 2008 analysis of PTB contacts concluded that the study of contacts is probably the activity with the highest performance for PTB detection in a control program. In this sense, timely detection of new cases allows adequate treat-
ment and interrupts the chain of transmission. In this research, we improved this indicator. Before carrying out this project, service providers started studying contacts two to three weeks after knowing the patient’s result and the study of contacts was below the goal. After the research, the study of contacts was carried out one to two days after receiving a positive PTB result, and a median of seven contacts was studied, when before only three were studied.

The Huasteca region of Hidalgo, for many years, has maintained the greatest number of PTB cases in the state and the greatest number of multi-drug resistance. Therefore, it is very probable that a history of chronic PTB infection exists in a family; this is important for preventive, therapeutic and epidemiological surveillance decision making. This was demonstrated in a study performed from 1991 to 2010 by Santana Cabral Silva., et al [22] who published in 2018 about factors associated with PTB in Brazil. Thus, it is concluded that the presence of one or more cases of retreatment and more than one case of contact at home is associated with a greater probability of suffering PTB. We recommend that all intra-residential contacts be investigated and treated, as was done in this research.

The lack of detection of suspicious cases, the deficient study of contacts, and unconcluded and unanalyzed treatment increase the probability of multi-drug resistant cases, as was documented by Torres-Chang., et al [23] in a study about risk factors associated with multi-drug resistant PTB (MDR-PTB). In this work, the authors concluded that there is a greater risk of MDR-PTB if incomplete treatment has been received and if there has been contact with patients that have a multi-drug resistant M. tuberculosis strain. In this regard, one limitation of our research was the failure to include aspects of treatment; however, in this first scientific study focused on the problem of PTB in the Huasteca region, we were able to discover that indeed the analysis of PTB is incomplete without the study of therapeutic aspects, a situation that will be addressed in a second report.

The application of the ISILOC methodology is only one component of the PTB control strategy that the state Mycobacteriosis programs must implement. Herrera and Farga [24,25], in a historical analysis of the TB Control Program in Chile, one of the most successful in Latin America, indicate that the effectiveness of a control program should evolve according to the scientific findings that are being obtained; in other words, based on the research studies carried out and the reported results, always adapting the actions of the program to improve its performance and thus contribute to the eradication of PTB.

Another limitation of our study was to have carried it out in only one of the 17 health regions in which the state of Hidalgo is divided. However, given the success of the intervention carried out in this research–action regarding the performance of the Mycobacteriosis program in this region, it is intended to extend this successful experience for gradual implementation in other regions of the state.

Acknowledgments

The authors wish to especially thank the personnel of the Mycobacteriosis program of the Huejutla Jurisdiction for their support and participation in the project: Basilio Velasco-Hernández, Jurisdiction Subdirector; Dr. Elizabeth Martínez-Hernández, in charge of the Jurisdictional PTB Program; Nurse Iris Ariadna Martínez-Granados, in charge of the TAES network and medical and nursing staff of the participating medical units.

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**Volume 9 Issue 7 July 2020**  
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*Citation:* Ocampo-Torres Moses., *et al.* "Evaluation of Pulmonary Tuberculosis Case Detection in Huejutla, Hidalgo According to the Synthetic Case Location Indicator (ISILOC)". *EC Pulmonology and Respiratory Medicine* 9.7 (2020): 111-120.