

TUBERCULOSIS CONTACT INVESTIGATIONS AND OUTBREAKS IN CHILDREN AND ADOLESCENTS

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Abstract: In tuberculosis (TB) control, early diagnosis and treatment of patients and contact investigations (CIs) are a priority, as these, in turn, facilitate the early diagnosis and treatment of newly infected individuals and patients.

In addition, if a child is diagnosed with TB and the index case has not been identified, a contact investigation should be started to find the source of infection.

Keywords: tuberculosis infection, risk of infection, concentric circle scheme.

ESTUDO DE CONTACTOS E SURTOS DE TUBERCULOSE NA POPULAÇÃO INFANTIL

Resumo: Para o controlo da tuberculose (TB), o diagnóstico e o tratamento precoce dos doentes e o estudo dos contactos (EC) são prioritários, o que, por sua vez, possibilitará o diagnóstico e o tratamento precoce de novos infetados e doentes.

Da mesma forma, se uma criança com tuberculose for identificada e o caso fonte não for detetado, deve ser iniciada uma investigação para descobrir a origem da infeção e estudar os seus contactos.

Palavras-chave: infeção tuberculosa, risco de infeção, esquema de círculos concêntricos

ESTUDIO DE CONTACTOS Y BROTES DE TUBERCULOSIS EN POBLACIÓN INFANTOJUVENIL

Resumen. Para el control de la tuberculosis (TB) son prioritarios el diagnóstico y tratamiento precoz de los enfermos y el estudio de contactos (EC) lo que, a su vez, posibilitará el diagnóstico y tratamiento precoz de nuevos infectados y enfermos.

Asimismo, si se identifica a un menor con TB y no se ha detectado el caso fuente, deberá iniciarse una investigación para buscar el origen de la infección y estudiar a sus contactos.

Palabras clave: infección tuberculosa, riesgo de infección, esquema de círculos concéntricos.

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INTRODUCTION

One of the fundamental pillars of the fight against tuberculosis (TB) is addressing the family and social environment of each patient. Each bacilliferous patient may infect about 20 individuals, especially when they live close to each other. Of the infected individuals, a non-negligible percentage (5 to 10%) will develop tuberculosis disease.

Mycobacterium tuberculosis is a slow-growing microorganism that, especially in its initial stages, causes silent symptoms or no symptoms at all. This may lead to a late diagnosis which, in turn, would favour the occurrence of a TB outbreak.

For intervention purposes, an outbreak is considered to be the occurrence of one or more cases of TB originating from the same index case within one year after the diagnosis of the primary case. When case clusters have been established using molecular techniques, clustering is defined as the detection of two or more cases of TB with identical RFLP-IS6110 patterns, or, in strains with less than six bands of the RFLP-IS6110 pattern, the strains that share the same spoligotyping, PGRS-RFLP, or MIRU-VNTR patterns (Centro Nacional de Epidemiología. Instituto de Salud Carlos III. Red Nacional de Vigilancia Epidemiológica, 2013).

The occurrence of an outbreak may be favoured by various factors such as the following:

- Characteristics of the index case: cases of pulmonary or laryngeal TB, with positive sputum bacilloscopy, lung cavitation, or wet cough.
- Characteristics of the exposure: place of contact, environment and physical conditions of ventilation and air renewal, duration of exposure, and socialisation.
- Contact characteristics: age (under 5 years), immunological status (especially HIV immunosuppression), and other medical conditions.

The detection of TB outbreaks is one of the main activities for the control of this disease. The study of outbreaks provides information about the transmission and the environment where the disease occurs.

The objectives of contact investigation are to successfully interrupt the chain of transmission of TB and to prevent future cases and disease outbreaks from occurring. It is also important to note that all TB cases begin as a TB contact.

CONTACT INVESTIGATION METHODOLOGY

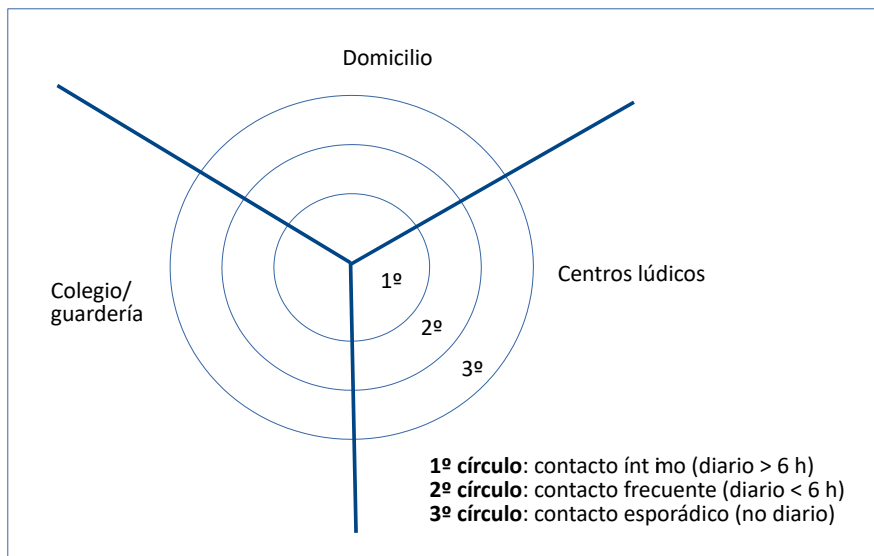
All healthcare workers taking care of TB patients should make sure that the individuals who have been in close contact with patients with potentially communicable TB are assessed and treated in accordance with international recommendations.

Whenever possible, the chain of transmission should be re-created to identify the initial case (especially in children under 15 years of age). This will be done by following the concentric circle approach (Figure 1. Classification of contacts according to the concentric circle approach) (Table 1. Figure 1. Classification of contacts according to the concentric circle approach Transaltion), which classifies contacts into high, medium, and low risk:

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1. High risk of infection (high-risk contact, close contact): bacilliferous index case and/or exposure to an environment favourable to transmission for at least 6 hours a day, or for a shorter period of time if the contact's immune system is compromised, if the individual is under 5 years of age, or if the source of infection is part of a micro-epidemic. This includes cohabiting contacts, non-cohabiting contacts (children sharing the same classroom or premises, school, kindergarten, nursery school, and other educational or social centres, and circle of close friends), and contacts in closed groups.
2. Medium risk of infection (frequent contact): exposure to an environment favourable to transmission for less than 6 hours a day, without the conditions mentioned in the previous point.
3. Low risk of infection (sporadic contact): when the risk of infection is similar to that of the general population. Non-daily contact.

Figure 1. Classification of contacts according to the concentric circle approach



Source: Adapted from: Documento de consenso sobre el estudio de contactos en los pacientes tuberculosos (Alcaide et al., 1999)

Table 1. Figure 1. Classification of contacts according to the concentric circle approach Transaltion

Spanish	English
Domicilio	Home
Colegio/guardería	School/Nursery
Centros lúdicos	Leisure centres
1º círculo: contacto íntimo (diario > 6 h)	1st circle: close contact (daily > 6 h)
2º círculo: contacto frecuente (diario < 6 h)	2nd circle: frequent contact (daily < 6 h)
3º círculo: contacto esporádico (no diario)	3rd circle: sporadic contact (not daily)

According to this model, the study should be initiated by investigating the contacts who are most at risk (the first circle), and then be extended until the prevalence of infection found is as expected in that population. If a new bacilliferous case is detected among the contacts, the concentric circle approach must be initiated once again starting from this case.

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The urgency of the initiation of a CI and its extent should be based on the likelihood of transmission of the infection and its possible consequences, especially in children and immunosuppressed contacts, whose risk of becoming ill after infection is higher (Table 2. Risk of TB after infection in immunocompetent children).

Table 2. Risk of TB after infection in immunocompetent children

Age at <i>Mycobacterium tuberculosis</i> infection	Risk of pulmonary disease or mediastinal lymphadenopathy (%)	Risk of meningeal or disseminated tuberculosis (%)
< 12 months of age	30-40	10-20
12-24 months of age	10-20	2-5
2-4 years of age	5	0.5
5-10 years of age	2	< 0.5
> 10 years of age	10-20	< 0.5

Source: Adapted from: (Erkens et al., 2010). Tuberculosis contact investigation in low prevalence countries: a European consensus.

1. CI phases and action guidelines

- Index case assessment and transmission locations.

Determining the time period in which the index case might have become a source of infection is important and may be achieved by conducting a survey. However, when this is not possible, the following are accepted:

- Three months prior to diagnosis when the index case is bacilliferous and/or presents with cavitations in radiological images.
- One month prior to diagnosis when the index case is not bacilliferous.
- Three months prior to diagnosis in HIV-immunosuppressed patients, often with atypical chest X-rays that can delay diagnosis and increase the transmission period.
- Preparation of the contact census.
- Prioritisation and classification.
- Tuberculin test (TT)/ interferon gamma release assay test (IGRA): In the context of a CI, indurations of ≥ 5 mm in children, HIV-positive individuals, immunosuppressed individuals, close contacts of bacilliferous patients, and individuals with x-ray lesions suggestive of previous untreated TB are considered to be positive (whether or not they have been BCG-vaccinated).
- Chest X-rays of the selected positives and contacts (see below), to rule out disease.
- Diagnosis and contact management.

Depending on the results, the contacts are classified as follows:

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- Not infected: chemoprophylaxis (CP) should be considered following the criteria set out in the article ADDRESSING TUBERCULOSIS IN CHILDREN (exposed child). The test should be repeated at 8-12 weeks in high and medium priority contacts.
 - Infected, but not diseased: treatment of TB infection (TTI) should be considered following the criteria set out in the article ADDRESSING TUBERCULOSIS IN CHILDREN (infected child).
 - Diseased individuals: their treatment is established and the investigation of their contacts is organised.
- Treatment supervision and follow-up.
 - Expanding the CI, if necessary.
 - Recruitment of contacts who had not been investigated previously and individuals who failed to comply with the treatment.
 - Closure and final assessment.

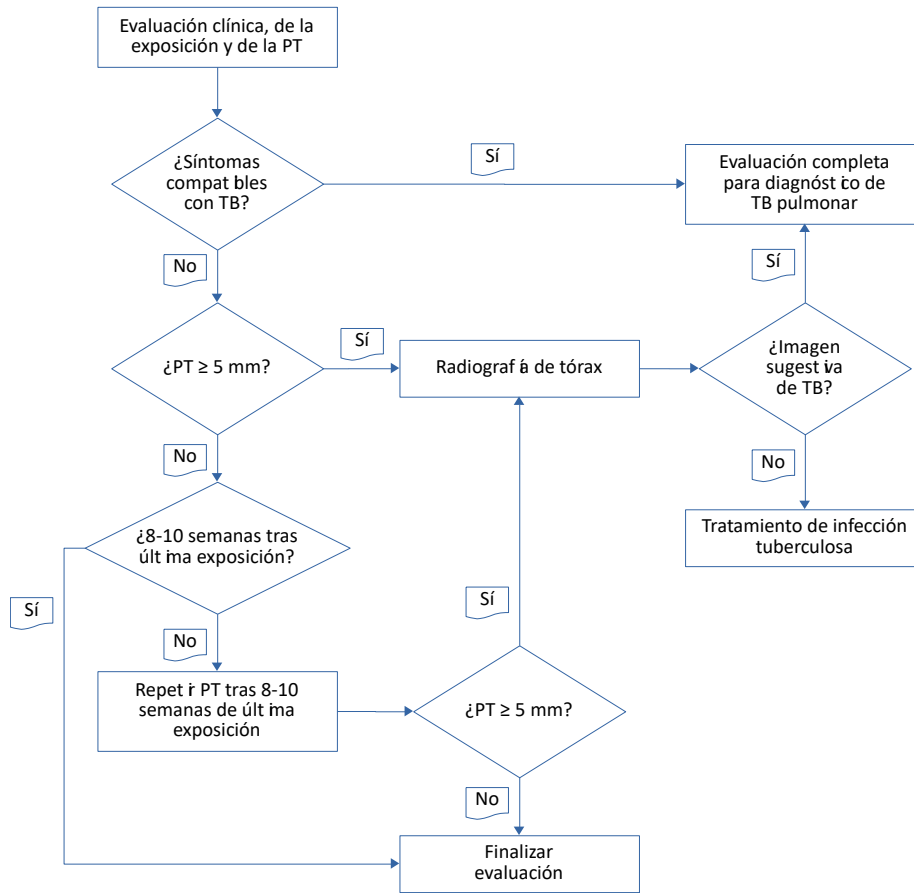
The complete case history of each contact must be prepared, placing special emphasis on the presence of symptoms consistent with TB, history of TB disease, BCG vaccination, previous TTs, history of preventive treatment, and the presence of risk factors. The following situations may arise:

- Contacts with a history of TB, or with previous positive TT/IGRA, or who have previously completed a cycle of TTI: TT should be skipped; active disease should be ruled out directly.
- Contact with symptoms consistent with TB: the presence of disease should be ruled out through chest X-rays and appropriate microbiological testing (in addition to TT or IGRA).
- Contact with no symptoms and no history of TB: the scheme in (Figure 2. Assessment and treatment of high and medium priority contacts)(Table 3. Figure 2. Assessment and treatment of high and medium priority contacts Translation) should be followed.

Both TT and IGRA techniques can be used in CIs (World Health Organization, 2018), and if they need to be repeated, it is advisable to perform the same test as the initial one. These tests are only indicated for diagnosing infection in individuals with a high risk of developing the disease who can benefit from preventive treatment. This treatment should be accompanied by a follow-up plan until completion. For low-risk individuals (sporadic contacts), these techniques are not indicated.

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Figure 2. Assessment and treatment of high and medium priority contacts



TT: tuberculine test; TB: tuberculosis

Source: adapted from: Guidelines for the investigation of contacts of persons with infectious tuberculosis; recommendations from The National Tuberculosis Controllers Association and CDC, and Guidelines for using the Quantiferon-TB Gold Test for detecting Mycobacterium tuberculosis Infection (National Tuberculosis Controllers Association; Center for Disease Control and Prevention, 2005).

Table 3. Figure 2. Assessment and treatment of high and medium priority contacts Translation

Spanish	English
Sí	Yes
No	No
Evaluación clínica de la exposición y de la PT	Clinical assessments, exposure assessments, and TT assessments
¿Síntomas compatibles con TB?	Are symptoms consistent with TB?
Evaluación completa para diagnóstico de TB pulmonar	Complete examination for diagnosing pulmonary TB
¿PT ≥ 5 mm?	TT ≥ 5 mm?
Radiografía de tórax	Chest X-ray
¿Imagen sugestiva de TB?	Does the image suggest presence of TB?
¿8-10 semanas tras última exposición?	8-10 weeks since last exposure?
Tratamiento de infección tuberculosa	Treatment for TB infection
Repetir PT tras 8-10 semanas de última exposición	Repeat TT at 8-10 weeks after the last exposure
Finalizar evaluación	End of assessment

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2. CI in schools and nurseries

The census of contacts in schools may include a large number of children, so communicating the actions to be carried out to staff, parents, and the general public is important to prevent anxiety and unnecessary media attention.

The staff that will conduct the CI must visit the centre to see how the classrooms and interior spaces are distributed and check ventilation and other general conditions. After-school activities and school bus trips should also be investigated.

When the index case is a child under 5 years of age, everyone living with them, their relatives, and close contacts should be investigated in search of the initial case. If the initial case is not found in this environment, the CI should be extended to the adults in contact with them in the educational centre.

All contacts classified as high priority (close contacts) who had not had a prior positive TT or a prior TB disease should have a TT/IGRA at the first visit. If this is not possible, the investigation should be carried out within one week. This period should be less than two weeks in the case of medium priority contacts (frequent contacts) (National Tuberculosis Controllers Association; Center for Disease Control and Prevention, 2005).

3. TB outbreaks in children and young adolescents

An outbreak investigation involves several overlapping contact investigations, with the resulting need for increased public health resources.

A TB outbreak in children may indicate a possible widespread transmission of TB. These are the main aspects to be considered in these investigations:

1. Children should be prioritised according to their degree of exposure (the number of hours in the same classroom per week).
2. Properly communicating with and informing staff, parents, and the general public, as well as to the media, is essential.
3. When the index case is a student and the source of infection is unknown, further investigation is needed to find the initial case.
4. When the index case is a teacher, the children in his or her classroom and other staff with whom he or she has had contact with will be examined.
5. In any case, negative TTs will be repeated two months after the last contact with the patient.
6. The need to extend the CI to other groups, such as dining room partners, etc., may be considered.

Early diagnosis, appropriate treatment of all cases of TB disease, and rapid identification of individuals who have been exposed to a source of infection should be the priorities of any TB programme in order to avoid infection or to prevent developing the disease.

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