

TUBERCULOSIS (TB)

CDNA NATIONAL GUIDELINES FOR THE PUBLIC HEALTH MANAGEMENT OF TB

Revision history			
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The Series of National Guidelines have been developed in consultation with the Communicable Disease Network Australia and endorsed by the Australian Health Protection Principal Committee (AHPPC). Their purpose is to provide nationally consistent advice and guidance to public health units (PHUs) in responding to a notifiable disease event. These guidelines capture the knowledge of experienced professionals, built on past research efforts, and provide advice on best practice based upon the best available evidence at the time of completion.

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TUBERCULOSIS (TB)

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1. Summary

The most important priorities for TB control and prevention are:

1. The timely identification and treatment of persons with active TB.
2. The detection of new infection in contacts of TB cases.
3. Targeted screening of high risk groups.

This guideline document focuses on the public health aspects of the management of a new TB case.

Public health priority

- High for sputum smear positive, pulmonary (including laryngeal) TB cases.
- Routine for other TB cases.

Case management

- Assess infectiousness of the case.
- Treating physicians are responsible for:
 - notification of proven or suspected TB cases in accordance with state public and environmental health laws.
 - implementing appropriate treatment in a timely manner with support provided by public health/TB services.
- Hospitalised infectious or potentially infectious cases should be isolated in a negative pressure room and airborne precautions applied.
- Infectious cases must be excluded from workplaces, educational and childcare settings as required.

Contact management

- Conduct an investigation to:
 - determine the source of infection in the index case.
 - screen contacts to identify the newly infected, with persons in close prolonged contact with pulmonary cases as first priority.
- Any contacts with symptoms suspicious of TB should be referred immediately for review.
- Any asymptomatic contacts with an abnormal screening result suspicious of recent infection (positive tuberculin skin test (TST) and/or interferon gamma release assay (IGRA), abnormal chest x-ray (CXR)), should be referred to a medical practitioner experienced in TB to exclude active disease and consider preventive treatment as appropriate.
- An evaluation of results of contact tracing in each risk group should be carried out to determine if contact management activity should be extended or ceased.

Note:

The following definitions will assist with the reading of this document:

Tuberculosis (TB) is the terminology for 'active' disease due to the *Mycobacterium tuberculosis* complex.

Latent TB infection refers to infection only, with the *M. tuberculosis* complex, without active disease (i.e. a dormant infection not able to be transmitted) and is referred to as LTBI.

Index case is the case with confirmed TB.

Source case is the case most likely to have transmitted TB to the index case.

Multi-drug resistant tuberculosis (MDRTB) is defined as strains showing resistance to at least isoniazid and rifampicin.

2. The disease

Infectious agents

TB is caused by the *M. tuberculosis* complex. *M. tuberculosis* is responsible for most cases. *Mycobacterium bovis* (*M. bovis*)*, *M. africanum*, *M. canettii* and *M. caprae* also cause a small number of TB cases in Australia.

Reservoir

Humans are the primary reservoir for *M. tuberculosis* complex, although it is also found in other animals, predominantly primates.¹ *M. bovis* particularly is found in cattle and other mammals.

Mode of transmission

- TB is transmitted mainly by inhalation of infectious droplets produced by persons with pulmonary or laryngeal tuberculosis during coughing, laughing, shouting, singing or sneezing.
- Transmission can occur from potentially high risk procedures including sputum induction, treatment using a nebuliser, bronchoscopy, drainage of an open abscess, autopsy or any procedure in which an aerosol containing *M. tuberculosis* is generated.
- Rarely, invasion of *M. tuberculosis* may occur through mucous membranes or damaged skin.
- Extra-pulmonary tuberculosis, other than laryngeal, is generally not communicable, although can be associated with pulmonary tuberculosis.
- *M. bovis* tuberculosis results mainly from ingestion of unpasteurised milk and dairy products.
- Aerosol transmission of *M. bovis* has been reported among abattoir and dairy workers and other workers butchering or cutting infected animals (e.g. cattlemen, veterinarians).

Incubation period

The time from infection to the primary lesion or measurable significant immunological reaction e.g. response to tuberculin Purified Protein Derivative (PPD), can vary from 2-10 weeks.¹ In the immunocompetent host, subsequent progression to active TB occurs in only 5–10 per cent of those infected. This progression can occur from weeks to decades later although half will occur within 2 years from initial infection. Infection with the *M. tuberculosis complex* without disease, often referred to as LTBI, can persist for a lifetime.

Infectious period

A person is infectious as long as viable bacilli are being discharged from the sputum. In practice, the greatest risk of transmitting infection is in the period prior to diagnosis and effective treatment of a pulmonary TB case. The risk of transmitting infection is reduced within days to two weeks after commencing appropriate TB treatment providing there is no drug resistant TB. A sputum smear positive case is more infectious than a case that is only culture positive.

* Note that *M. bovis* isolated from urogenital sites from persons with therapeutic BCG instillation are excluded as cases.

The degree of communicability depends on:

- intimacy and duration of exposure.
- number of bacilli discharged, infectivity of bacilli.
- adequacy of ventilation and exposure of bacilli to sun or UV light.
- opportunities for aerosolization.¹

Clinical presentation and outcome

Over half of all cases in Australia present with pulmonary TB (disease involving the lungs) and can have the following common symptoms:

- A chronic cough, sometimes accompanied by haemoptysis
- Fever and night sweats
- Loss of weight
- Feeling generally tired and unwell.

Clinical suspicion of TB should be high in any person with exposure risk factors and a respiratory infection unresponsive to standard treatments or an unexplained non-respiratory illness. This particularly includes:

- new arrivals and recently returned travellers from high incidence countries
- contacts of an active case within the past 5 years
- those with a history of previous TB treatment
- Indigenous Australians in localised areas (eg Northern Territory, Queensland)
- HIV positive patients.

Non-pulmonary TB (disease involving organs other than lungs) can present with a wide range of symptoms dependant on the site of disease and is often accompanied by intermittent fever or weight loss.

A person with LTBI has no symptoms and is not infectious.

The use of standardised TB treatment for an appropriate period of time will result in cure rates over 98 per cent in drug sensitive disease.² Deaths from TB in the Australian setting should be a rare occurrence and usually reflect co-morbidities and delayed or missed diagnosis and treatment. The success of treatment relies heavily on health care provider compliance, ensuring the right treatment is prescribed i.e. the right dose, drug combination and duration with the capacity to deliver the drugs without supply interruption, and patient adherence. Health care provider compliance and patient adherence are important to prevent the development of drug resistance and relapse. The disease does not always confer protective immunity as reinfection can occur.

Persons at increased risk of disease due to exposure and/or susceptibility

Those at increased risk of infection due to risk of exposure include:

- those in close contact with a case of TB (including household members)
- overseas-born health care workers (HCW) and HCW returning from working in high incidence countries
- new arrivals from countries (e.g. South Africa, Philippines, Vietnam, India, South Korea, Malaysia and China) or areas (e.g. in Africa or Pacific Islands) with a high incidence of TB

- people living in overcrowded conditions (e.g. some Indigenous Australians communities) or in institutions.

Almost everyone is susceptible to infection, however some groups are more susceptible to infection and progression to active TB than others. Those at increased risk of infection due to clinical vulnerability include those with HIV infection and other forms of immuno-suppression.

The risk of developing the disease once infected is high in the following groups of people ³:

- children under 5 years of age, adolescents and the elderly
- those who are malnourished
- those immuno-compromised by disease, such as people living with HIV, diabetes and renal failure
- those on immuno-modulating therapies such as corticosteroids, anti-TNF inhibitors and anti-cancer treatments.

People with features consistent with inactive TB on CXR (e.g. fibrotic areas, apical scarring or blunted costo-phrenic angles) are at increased risk of progression to disease.

Aboriginal people and Torres Strait Islanders in some parts of Australia are at increased risk of TB due to adverse social and health factors. These include overcrowding and high rates of chronic diseases that increase the risk of reactivation of TB and some that can confound the diagnosis of TB such as the presence of chronic lung disease.⁴

Disease occurrence and public health significance

The World Health Organization (WHO) estimated the global burden of TB in 2010 at 8.8 million incident cases (128 cases per 100,000 population) with an associated 1.4 million deaths, most of which occurred in Asia and Africa.⁵ The prevalence of TB was approximately 12 million cases (178 per 100,000 population) in 2010. Approximately 1.1 million (12-14%) of the estimated incident cases were HIV-positive with Africa accounting for 82% of these. The estimated number of prevalent cases of multi-drug-resistant TB (MDR-TB) was 650,000 (5.4%).⁵ The proportion of new and retreatment cases estimated to be MDR-TB was 3.4% (CI 1.1-5) and 20% (CI 14-25) respectively.⁵

In Australia the rate of TB notifications has remained relatively stable since 1986. In 2009 there were 1,322 cases (6.0 per 100,000 population) of TB reported in Australia.⁶ These rates compare favorably with other developed countries. Although rates of TB in Australia have remained low, specific subgroups such as Indigenous people and persons born overseas, still have rates many times those of non-Indigenous Australian-born persons.^{4, 6}

Drug resistant TB has emerged globally and represents an ongoing concern in Australia. In Australia 2 to 3% of cases are resistant to at least isoniazid and rifampicin (defined as MDR-TB).⁷ Extensively drug-resistant TB (XDR-TB) is MDR-TB with resistance also to any fluoroquinolone and any of the second-line anti-TB injectable drugs, amikacin, kanamycin or capreomycin. Although XDR-TB is uncommon in Australia, approximately 25,000 XDR-TB cases are estimated to emerge globally every year and are associated with high mortality.⁸ The prevalence of MDR-TB and XDR-TB often reflect programmatic weaknesses in the countries where the disease was acquired. Compared to the treatment of drug-sensitive disease, the treatment of MDR-TB and XDR-TB takes considerably longer (up to 2 years or more to

complete), requires multiple drugs that are less potent and more toxic, and outcomes are poorer.

3. Routine prevention activities

TB Program activities

The most effective means of preventing transmission of TB is early diagnosis and prompt effective treatment. Case management and contact screening undertaken by TB services are important public health measures in minimising transmission of infection and preventing emergence of drug resistance.

Border screening

Pre migration

Migrants, refugees, irregular maritime arrivals (IMA) and long-term visitors to Australia are screened for evidence of TB prior to being granted a visa. Active TB is the only condition where automatic exclusion from entry into Australia is regulated. To minimise the potential for transmission of TB within Australia extensive pre migration screening for TB is undertaken by the Department of Immigration and Citizenship.

Post migration

Post migration screening is carried out in conjunction with jurisdictional TB Prevention and Control Services. Post migration follow-up screening (often referred to as a "TB Undertaking – TBU") is carried out on those identified pre migration as having previous TB or with a suspicious CXR (but no proven active TB pre migration) or on those not fully screened (e.g. due to pregnancy).

Screening for LTBI is recommended in some groups e.g. refugees⁹, but uniform LTBI screening is not done systematically.

Vaccination

Bacille Calmette-Guerin (BCG) vaccination is an effective vaccine in reducing the risk of TB meningitis and disseminated disease in children aged <5 years in countries of high TB prevalence.¹ It has limited application however in countries where the incidence of TB is low and is not recommended for general use in Australia as its overall efficacy is low. It is only recommended for specific high-risk groups^{10,11} such as:

- Aboriginal and Torres Strait Islander neonates in communities of high incidence of TB.
- Neonates and children <5 years of age who will be travelling or living in countries or areas with a high prevalence of TB for extended periods.
- Neonates born to parents with leprosy or a family history of leprosy.

BCG vaccination may also be considered for:

- Children > 5 years of age who will be travelling or living in countries or areas with a high prevalence of TB for extended periods.
- HCWs who may be at high risk of exposure to drug resistant TB.

4. Surveillance objectives

- To identify and treat infectious cases of TB in a timely manner.
- To identify infected contacts and reduce their risk of developing active TB.
- To monitor the epidemiology of TB in Australia to better inform prevention strategies.
- To identify and monitor drug resistance.
- To identify and monitor TB-HIV co-infection.

5. Data management

All cases fulfilling the TB case definition are to be notified and data entered onto jurisdictional disease databases. Each year's core and enhanced data is to be completed by August of the following year. Outcome data for cases needs to be updated by August 2 years following the end of the notification year.

Core de-identified data on all confirmed cases of TB are reported to the Commonwealth via the National Notifiable Disease Surveillance System (NNDSS) on a regular basis. Enhanced data are collected for each notified case of TB, which includes risk factor information, clinical diagnostics and treatment outcomes.

Data on TB cases in Australia are reported to WHO annually. Data are reported to WHO by the May following the end of the reporting year, acknowledging that data is preliminary at this point in time.

6. Communications

Once a TB case is known to public health or TB services, there are situations when Communicable Disease Directors (or their nominated delegate) of the relevant jurisdiction should be immediately notified. These include when:

- a case or related contact screening is likely to attract media attention.
- the case may have been nosocomially acquired.
- screening has discovered significant infection (i.e. infection beyond family contacts) that is considered to be a result of recent transmission.
- a case requires enhanced contact investigation in a congregate setting.
- Further reporting of cases and need for contact tracing within or between jurisdictions is made by the jurisdictional TB staff of the index case, on a case by case basis, in accordance with jurisdictional protocols. Communicable Disease Directors (or their nominated delegate) are informed of cross border actions.

7. Case definition

Confirmed cases of TB, which include clinically diagnosed TB, should be notified as a legislative requirement. The case definition of a confirmed case can be found at:

www.health.gov.au/casedefinitions

8. Laboratory testing

Testing guidelines

Laboratory testing for TB is indicated in people with a clinically compatible illness, particularly if they are at increased risk of TB.

Pulmonary TB:

- Sputum should be collected as early-morning samples on 3 separate days for highest sensitivity.
- The “spot-morning-spot” protocol of a spot sputum collected when seen, then the next morning and again when seen the next day is efficient, almost as sensitive as 3 separate day collections and more convenient for out-patients.
- Sputum induction (using nebulised hypertonic saline) or gastric lavage may be attempted in appropriate patients unable to expectorate.
- Sputum collection from patients at high-risk of having TB should be performed in negative-pressure ventilation rooms. Sputum collection from low-risk patients should be performed in well-ventilated areas away from other patients.
- In settings where patients at high risk of (or with known) infectious TB require cough-inducing procedures HCWs should wear respiratory protection (i.e. P2/N95-standard mask or powered air-purifying respirator).
- Sputum samples should be collected in sterile, wide-mouth containers with a screw-cap lid.

Extra-pulmonary TB:

- The investigation of extra-pulmonary TB is often problematic and requires the collection of samples from normally-sterile sites (e.g. CSF, bone, lymph node, and peritoneum) by radiological guidance or at operation.
- Surgeons and operating room staff must be specifically directed to place specimens in saline and NOT formalin so that culture and drug susceptibility testing are possible.

Microscopy and culture

- Only about 60% of culture-positive respiratory specimens will be smear-positive. Additionally smear microscopy cannot reliably differentiate *M. tuberculosis* bacilli from other non-tuberculous mycobacteria (NTM). Microscopy therefore lacks sensitivity (so a negative result does not exclude tuberculosis) and specificity (“false-positive” results may occur due to the presence of NTMs). Smear positive cases should be treated as TB until proven otherwise.
- Smear results should be available within 24-48 hours of specimen receipt and provide a measure of the infectivity of the patient (i.e. smear-positive cases have a heavy burden of acid-fast bacilli (AFB) in their sputa that can be transmitted by coughing, singing, etc).
- Culture remains the definitive “gold standard” investigation for TB and in contrast to microscopy, culture is highly sensitive.
- The initial culture and identification of *M. tuberculosis* still takes an average of 10-14 days with the subsequent susceptibility results expected within 15-30 days of specimen receipt.
- Still, culture is not 100% sensitive or specific and about 20% of TB cases each year in Australia are not laboratory-confirmed. Rarely culture is open to laboratory cross-contamination of AFBs from a “strong-positive” sample to a “true-negative” sample.

Drug susceptibility testing

The NTAC Guidelines for Australian Mycobacteriology Laboratories stipulate that drug susceptibility testing (DST) should be performed on:

- all initial isolates of *M. tuberculosis*;
- isolates from patients who remain culture-positive after 3 months of treatment;
- isolates from patients who are clinically failing treatment; or
- an initial isolate from a patient relapsing after previously successful TB treatment.

The minimum DST that should be performed are for isoniazid (high- and low-level concentrations as appropriate), rifampicin, ethambutol, +/- streptomycin. Some experts believe that patients infected with strains exhibiting low-level resistance to isoniazid may benefit from continuing therapy with isoniazid. A specialist in the treatment of tuberculosis should be consulted regarding the appropriate therapeutic regimen and dosages for treatment.

Nucleic acid amplification tests (NAAT)/PCR

- NAAT has a sensitivity intermediate between that of microscopy and culture. Commercial NAAT assays have a high sensitivity (>95%) in smear-positive specimens, but lower sensitivity (17-80%) in smear-negative specimens and therefore a negative result does not exclude TB.
- NAAT take only hours to run and results are usually available within a day.
- Most NAAT assays have been validated only on respiratory specimens so their performance characteristics on extra-pulmonary samples are uncertain.
- The NTAC Guidelines for Australian Mycobacteriology Laboratories includes principles for the use of NAAT.
- The Xpert MTB/RIF assay (Cepheid, Sunnyvale, Calif) that detects both *M. tuberculosis* and rifampicin resistance (an indicator for possible MDRTB) broadens the indications for NAAT. This and other new technologies are under active review by NTAC and other national expert groups. The reader is advised to liaise with their servicing laboratory regarding their current indications for NAAT.
- NAAT does not replace culture as the latter remains the most sensitive test and essential for DST.

Sub-typing of *M. tuberculosis*

- The Australian Mycobacterium Reference Laboratory Network (MRLN) performs molecular epidemiological typing by a nationally-approved method on the initial isolate from every referred *M. tuberculosis* patient. The current approved method is called mycobacterial interspersed repetitive unit-variable-number tandem repeat (MIRU-VNTR) typing.
- Molecular genotyping in Australia is confounded by the presence of common strains of *M. tuberculosis* (eg. the "Beijing" strain) among migrants, who account for 85-90% of TB cases. Hence, if 2 migrants present with the same common MIRU profile, genotyping cannot differentiate between recent transmission in Australia and reactivation of distant infection with a common strain from their homeland.

List of Reference Laboratories

The Australian MRLN comprises the mycobacteriology laboratories at the following institutions: Institute of Clinical Pathology and Medical Research, Westmead Hospital, Westmead, New South Wales.

PathWest Laboratory Medicine Western Australia – Queen Elizabeth II Medical Centre, Hospital Avenue, Nedlands, Western Australia

Queensland Health Pathology Services, Herston, Hospitals Complex, Herston, Queensland.

SA Pathology, Adelaide, South Australia.

Victorian Infectious Diseases Reference Laboratory, North Melbourne, Victoria.

For further information on laboratory testing, refer to:

The Public Health Laboratory Network (PHLN) laboratory case definitions website:

<http://www.health.gov.au/internet/main/publishing.nsf/Content/Laboratory+case+definitions-1>

National Tuberculosis Advisory Committee. Guidelines for Australian Mycobacteriology Laboratories. *Commun Dis Intell* 2006; 30: 116-128.

www.health.gov.au/ntac

9. Case management

Response times

Follow up of sputum smear positive, pulmonary TB notifications for treatment, respiratory isolation (if not already in place) and initiation of contact tracing assessment should begin within 1 working day of receipt of notification. All other cases should be followed up within 3 working days.

Response procedure

Case investigation

Generally, investigation of TB cases is undertaken by TB services staff using a disease investigation form (see example in Appendix 1), in collaboration with the case's health care providers. Wherever possible, seek the treating doctor's consent, however where this cannot happen in a timely fashion, follow up should proceed.

Regardless of who does the follow-up, the staff responsible should ensure that action has been taken to:

- confirm the onset date and symptoms of the illness.
- document the time of 1st contact with healthcare for symptoms.
- review results of relevant laboratory tests, and/or recommend that tests be done to confirm the diagnosis of TB.
- interview the case (or carer) and obtain history to inform the contact management plan (including possible exposures e.g. occupational, recreational, recent travel and identifying contacts); and if the index case is a child, emphasis is placed on identifying the possible source case as a matter of priority.
- culture positive pulmonary TB cases should have sputum collected when culture positivity is reported to see if the case has progressed to smear positive.
- extra-pulmonary TB cases have a CXR and sputum samples collected to determine possible co-existing pulmonary involvement.
- review case and contact management ensuring relevant respiratory isolation and infection control strategies are in place.

- ensure infection control professionals are notified where appropriate (e.g. in hospital).
- ensure (or confirm) with the TB staff that an appropriate treatment plan is in place.

As part of the case investigation, an assessment is made regarding the infectiousness of the case based on clinical, radiological and laboratory findings. The degree of infectiousness is categorised as follows:

Degree of infectiousness of case	Clinical, radiological and laboratory findings
High	<ul style="list-style-type: none"> • sputum smear positive or laryngeal involvement, and/or • cavitation on CXR, or • evidence of transmission to other contacts.
Medium	<ul style="list-style-type: none"> • smear negative sputum but sputum culture positive or nucleic acid test positive, or • pleural disease without pulmonary involvement, or • bronchial washings smear positive.
Low	<ul style="list-style-type: none"> • sputum culture and smear negative, or • smear positive and clinically unlikely to be TB.
Negligible or none	<ul style="list-style-type: none"> • extra-pulmonary TB (without associated pulmonary) e.g. pulmonary TB has been actively excluded by CXR and sputum tested for <i>M. tuberculosis</i> and for NTM disease.

Case treatment

Treating physicians are responsible for implementing appropriate treatment strategies in individual cases with support provided by public health/TB services to ensure adherence to the prescribed treatment therapy. All patients commenced on treatment for TB should have an assessment for likely adherence undertaken and best practice recommendation is for directly observed therapy (DOT). In certain cases DOT should be mandatory, e.g. a smear positive cavitory TB case, any retreatment case or a case with any drug resistance. Supervised TB treatment is provided to minimise the development of initial or further drug resistance, the recurrence of disease related to non-adherence or inappropriate TB treatment, to assist the patient in achieving cure and to document successful treatment completion.

Antibiotic therapy for fully susceptible *M. tuberculosis* continues for a minimum duration of 6 months. WHO recommend that all patients in settings such as Australia, where there is a reasonable likelihood of isoniazid resistance, should be commenced on standard 4 drug therapy.¹² For detailed information on therapeutic agents see the relevant jurisdictional guidance or the current edition of Therapeutic Guidelines: Antibiotic.¹³

Many patients can be treated on an outpatient basis. Hospitalisation may be required if:

- there is a need for continuous in-patient care due to complications from TB or other co-morbid conditions.
- investigations are required to establish the diagnosis.
- it is necessary to monitor adherence and/or tolerance of drug therapy.
- the patient is likely to be a public health risk (e.g. smear positive cases) or if social circumstances in the home necessitate admission.

Education

Education about the disease process and transmission of infection is provided to patients and household contacts using a qualified interpreter as appropriate. The importance of adherence to treatment is reinforced and further information provided about medications and possible side effects of drug therapy. Recognising there are many misconceptions about TB, effective communication and provision of clear information is a high priority for patient management. It is important to emphasise that TB is a curable and preventable disease. In many cultures unfortunately there is still much stigma associated with the disease. Support and reassurance are required. If treated at home for smear positive pulmonary TB, they must be instructed to remain there without visitors coming into the house until they are assessed as not being infectious. Language specific fact sheets about TB and drug treatment should be provided to all patients and are available from jurisdictional TB units.

Isolation and restriction

It is recommended that patients with suspected or confirmed pulmonary TB who are admitted to hospital should remain isolated in a negative pressure room with airborne precautions applied,¹⁴ until discharge criteria are met. In principle these criteria include:

- a reduction in or absence of cough
- reduced smear burden or smear negativity
- assured treatment
- an appropriate discharge plan.

If drug resistance is suspected then cases should remain in isolation with airborne precautions in place until susceptibility results are confirmed. If sputum remains smear positive, a decision about discharge should be made in consultation with a specialist physician with experience in managing TB and taking into account the social circumstances at home, such as the potential to expose new contacts and the presence of children <5 years of age.

Patients with pulmonary TB who are managed at home should be isolated until assessed as being at minimal risk of transmitting infection. Adequate social support and supervised therapy is essential in the home environment to maintain home isolation. Assessment of other family members should be undertaken as a matter of priority to determine their status and also the possible need for 'window' preventive therapy in any children <5 years of age with no initial evidence of infection. The patient and family must also be provided with appropriate education and counselling about minimizing the risk of transmission of infection – cough hygiene, avoiding new contacts and restricting movements away from home.

There are no restrictions on the movement of patients with extra-pulmonary disease, who have had pulmonary TB excluded or those with negative sputum smears on adequate therapy.

Cases must be excluded from educational facilities and children's services (including child care, family day care, kindergartens, after school care) as required under jurisdictional regulations.

A restriction order, e.g. under a Notifiable Diseases Act or similar, may be issued to a person with pulmonary TB who does not comply with prescribed treatment and is not willing to limit their movement within the community. Enactment of an isolation order is a last resort that follows extensive consultation between the treating clinicians and TB services, patient counselling, psychological assessment and use of alternative strategies to enhance adherence, including incentives and enablers.

10. Environmental evaluation

To assist in the identification of contacts at risk of infection, an environmental assessment should be undertaken of the settings that the patient has been spending time while infectious.

Factors to consider include:

- Ventilation
- Room size
- Proximity to the case
- Duration of contact – while 8 hours is often used as a minimum time to acquire TB infection, a lower threshold should be considered where more susceptible people are involved or people participate in a high risk procedure (induced coughing/intubation) or are in a high risk setting (post-mortem of an undiagnosed TB case).

11. Contact management

Identification of contacts

The aims of contact tracing are to:

- identify the source case.
- identify further cases of TB among those in contact with the disease.
- identify people who may have been infected following contact with a person found to have active TB.
- counsel people found to have LTBI and refer them for assessment.

The estimated risk of transmission should guide the priority, rapidity and thoroughness of the contact investigation.

The following steps should be undertaken by or in conjunction with the TB services:

1. Categorise the case according to the likely degree of infectiousness (see section 9 Case management).
2. Obtain a list of contacts and categorise the contacts according to their estimated risk of exposure to TB (see Contact definition below).
3. Assess all high risk contacts of suspected or confirmed pulmonary and laryngeal TB cases first.
4. Consider examination of medium risk contacts (see Contact definition below) of pulmonary or laryngeal TB cases if there is evidence of transmission in high risk contacts.

Contact definition

High risk contacts are either:

1. people who have had frequent, prolonged and close contact in an enclosed environment with an infectious case such as:
 - all people living in the same dwelling.
 - relatives and friends who have frequent, prolonged and close contact.
 - work colleagues who share the same indoor work area on a daily basis.

Or

2. people have not had as frequent, prolonged and close contact but are more susceptible to TB infection due to age (<5 years of age) or immune-suppressing factors.

Medium risk contacts – people who have had frequent but less intense contact with an infectious case. This group may include:

- other close relatives
- friends
- schoolmates
- work colleagues
- relatives and neighbours who frequently visit the case and are not included in the high risk group.

Low risk contacts - includes other contacts at school or in the workplace or social environments not included in the high or medium risk groups. Obtaining details of low risk contacts is not necessary initially and need only be pursued if there is evidence of transmission in the high risk and medium risk groups.

Each contact tracing activity needs to be developed and evaluated on an individual basis. After contact tracing has been carried out in each risk group, an evaluation of the results should be carried out to determine if transmission has occurred. As a guide, if the majority of the closest contacts have been tested and all are TST and/or IGRA negative and 3 months post contact, testing of more remote contacts is usually unnecessary.

Some timelines to guide the priority of screening are:

- high risk contacts of highly infectious cases should be assessed within 7 days of diagnosis, including high risk susceptible contacts.
- high risk contacts of cases of medium or low infectiousness should be assessed within 14 days of notification of diagnosis.
- screening of contacts of cases with negligible infectiousness should be dependent on the overall risk assessment.
- only if there is evidence of transmission in the high risk contacts group, should screening progress to the medium risk group.
- only if there is evidence of transmission in the medium risk group, should screening progress to the low risk group.

All contact tracing should be provided free of charge by TB services.

Management of identified contacts

- Contact investigation consists of:
 - history taking
 - TST and/or IGRA where indicated
 - radiographic examination.
- TST remains the preferred test for LTBI in most patient groups. IGRAs may be used as a supplement to TST in previously vaccinated immunocompetent contacts.¹⁵
- Information on the drug susceptibility pattern of the isolate from the source case should be acquired as it may influence approach to management of contacts.
- Recommendations to guide the management of identified contacts include:
 - All contacts with a positive TST and abnormal CXR must be referred to a medical practitioner experienced in the diagnosis and treatment of TB to exclude active TB.

- Contacts with a positive TST or positive IGRA should be referred to a medical practitioner experienced in the diagnosis and treatment of TB for assessment and consideration of treatment for LTBI.
- A TST of ≥ 5 mm is significant in contacts who are immunosuppressed or young children, and should be referred to a medical practitioner experienced in the diagnosis and treatment of TB for specialist advice.
- Children <5 years of age who are household contacts of a smear positive pulmonary case, should be referred to a medical practitioner experienced in the management of TB (in collaboration with the TB unit).
- Children <5 years of age who are not considered to have TB should be considered for commencement of preventive therapy (regardless of TST result) until infection is excluded.
- If the TST reaction is negative at the initial examination, the test should be repeated 8-12 weeks after the last exposure to the case and/or since treatment was commenced and the case considered no longer infectious.
- If preventive treatment is not given because of a medical contraindication or the patient refuses, then the individual should remain under clinical and radiological surveillance for at least 2 years.

Education

Contacts should be advised about the nature of TB infection and disease, its mode of transmission and the importance of adhering to follow up plans and treatment for LTBI (if prescribed) using a qualified interpreter as appropriate. Recognising there are many misconceptions about TB, effective communication and provision of clear information is a high priority. It is important to emphasise that TB is a curable and preventable disease. Counselling about the risks of reactivation of latent infection and awareness of symptoms must be provided to those with a positive TST and not treated. Language specific fact sheets about TB and drug treatment and about LTBI and treatment or follow up should be provided to all patients and are available from jurisdictional TB units.

Isolation and restriction

Contacts should not be isolated or restricted unless they have symptoms consistent with pulmonary TB or smear positive pulmonary disease is confirmed. Such TB suspects should be isolated until active TB is excluded (see section 9 Case management).

12. Special situations

MDR-TB and XDR-TB cases

Management (clinical, laboratory and public health) of the small number of MDR-TB cases seen in Australia should be multidisciplinary and co-ordinated by those with TB expertise.

Accurate detection of MDR-TB is reliant on culture and DST. The treatment regimen used is based on the results of DST and a detailed history of any previous treatment. All treatment should be directly observed and patients should be reviewed for at least 2 years after successful completion of treatment.¹⁶ Other key planning considerations include infection control aspects and regular monitoring to provide patient support, assess clinical progress and monitor side effects.

The approach to identifying infected contacts of the drug resistant case is the same as set out in section 11. Contact management. The risk of infection in contacts of an infectious MDR-TB case is not significantly different than for contacts of drug susceptible cases. However the management of infected contacts is problematic as there is no proven preventive treatment.

TB-HIV coinfection

Globally, TB is the most important opportunistic infection complicating HIV infection and is the leading cause of AIDS-related deaths. In Australia, dual infection with HIV and TB is much less common than in developing countries with approximately 3% of TB cases, with a known HIV test outcome, testing positive for HIV in 2008 and 2009.⁶ The interaction between HIV and TB infection is bidirectional. People with HIV infection are predisposed to reactivation of LTBI as well as rapid progression of recently acquired infection. The rate of progression from LTBI to active TB is as high as 5-10% per year compared to 5-10% over a lifetime in those without HIV infection. TB also impacts on the course of HIV infection. TB can be the initial manifestation of unrecognised HIV infection and patients with newly diagnosed TB should be HIV tested. The care of TB-HIV coinfecting cases should be referred to HIV specialist with TB experience. The public health management of these cases is essentially the same as outlined in section 9. Case management and section 11. Contact management.

TB in children

TB in children is different to adult TB in the following ways:

- infection is more likely to progress to active TB especially in infants and young children (<5 years of age). The younger the child when infected, the greater the risk of disease progression. Most cases will present within 2 years after infection.
- infection is more likely to result in disseminated disease and so extra-pulmonary TB is relatively more common in children. BCG reduces the risk of severe forms of disseminated disease such as TB meningitis.
- childhood TB is rarely contagious because it is usually characterised by paucibacillary disease. However, adolescents are at increased risk of TB compared to other school-aged children usually presenting with disease similar to adults, and so are often contagious.
- diagnosis of TB in children can be more difficult to confirm because it is usually characterised by paucibacillary disease and because it can be more challenging to obtain respiratory specimens for laboratory examination from young children.

The care of a child suspected of having TB should involve a clinician experienced in the management of TB in children. The public health management is essentially the same as outlined in section 9. Case management and section 11. Contact management with the recognition that contact tracing of children is mainly done to identify from whom the child acquired the TB. Identifying and treating children with LTBI is indicated to reduce the risk of developing disease both immediately after acquiring the infection (particularly in children <5 years of age) and to reduce their lifelong risk of developing disease. Choice of treatment of TB or LTBI in children will be influenced by the drug susceptibility profile of the source case (if known).

TB in health care facilities

Nosocomial transmission of TB can occur, particularly in cases where diagnosis is delayed. It is important that a high index of suspicion for TB is maintained, particularly in patients with respiratory symptoms and belonging to a high-risk group for TB, such as overseas born from high prevalence countries, known TB contacts, immune suppressed patients and the elderly (both Australian and overseas born).

All suspected or confirmed cases of pulmonary TB should be placed in a negative pressure room and airborne precautions applied, including use of particulate filter masks for HCW and surgical masks for patients during transport within the hospital.¹⁴ In the event of HCW exposed to an undiagnosed case of TB, appropriate contact tracing and screening measures must be implemented. Investigation and management will be the same as outlined in contact management (see section 11. Case management).

Health care facilities are required to have protocols and guidelines for routine tuberculosis prevention and management in place, including a TST screening policy. Laboratory staff, in particular TB laboratory staff and mortuary staff, need to be included in routine HCW TB screening.

TB in educational facilities, child care settings, special schools, community residential facilities and prisons.

Although contact identification and investigation follow the same principles as general contact tracing, clients in these settings may be more vulnerable to infection, at increased risk for progression to disease or give rise to needless anxiety in settings with limited understanding or stigma surrounding the disease. In addition, an index case in these settings will lead to increased family, staff and community anxiety and stress. Key messages to be communicated include the relative low communicability of TB, the lack of risk for contacts to transmit infection and reassurance about standard public health policy to identify and investigate contacts for evidence of infection.

Airline contact tracing of TB cases

Occasionally contact tracing of airline passengers may be required. This is more likely if:

- the patient was symptomatic at the time of travel
- sputum specimens are found to be direct smear positive for AFB
- the flight had a duration of 8 hours or more
- the time elapsed between flight and notification of case is within 3 months.

Passengers who travelled in the same row and 2 rows fore and aft of the index case should be advised by letter of their possible exposure to TB and offered appropriate assessment and screening. Letters are sent at 8–10 weeks after the flight to coincide with the optimum time for skin test conversion if infection has occurred. The same principles of contact management apply to airline contacts (see section 11. Case management). Refer to the CDNA Revised guidelines for the follow-up of communicable diseases reported among travellers on aeroplanes, available at: <http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-cdna-gl-airtravlers.htm>

13. References and additional sources of information

1. Heymann DL, editor. *Control of communicable diseases manual*. 19th edn. Baltimore: United Book Press; 2008.
2. Hong Kong Chest Service/British Medical Research Council. Five-year follow-up of a controlled trial of five 6-month regimens of chemotherapy for pulmonary tuberculosis *Am Rev Respir Dis* 1987;136(6):1339-1342.
3. Fitzgerald D, Sterling T, Haas D. *Mycobacterium tuberculosis*. In: Mandell GL, Bennett JE, Dolin R, editors. *Principles and practice of infectious diseases*. 7th edn. Philadelphia: Churchill Livingstone; 2010.
4. Barry C, Konstantinos A, and the National Tuberculosis Advisory Committee. Tuberculosis notifications in Australia, 2007 *Commun Dis Intell* 2009;33(3):394-315.
5. World Health Organization. Global tuberculosis control: WHO report 2011; 2011.
6. Barry C, Waring J, Stapledon R, Konstantinos A, and the National Tuberculosis Advisory Committee. Tuberculosis notifications in Australia, 2008 and 2009 *Commun Dis Intell* 2012;36(1):in press.
7. Lumb R, Bastian I, Carter R, Jelfs P, Keehner T, Sievers A. Tuberculosis in Australia: Bacteriologically confirmed cases and drug resistance 2008 and 2009. A report of the Australian Mycobacterium Reference Laboratory Network *Commun Dis Intell* 2011;35(2):154-161.
8. World Health Organization. Tuberculosis MDR-TB and XDR-TB 2011 Progress Report. 2011. Accessed on 12 Jan. Available from: http://www.who.int/tb/challenges/mdr/factsheet_mdr_progress_march2011.pdf
9. Australian Society for Infectious Diseases. Diagnosis, management and prevention of infections in recently arrived refugees. Sydney; 2009.
10. Australian Technical Advisory Group on Immunisation, Australian Government Department of Health and Ageing. *The Australian Immunisation Handbook*. 9th edn. Canberra: Australian Government; 2008.
11. National Tuberculosis Advisory Committee. The BCG vaccine: Information and recommendations for use in Australia, Update April 2012. *Commun Dis Intell* in press.
12. World Health Organization. *Treatment of Tuberculosis Guidelines*. Fourth edn. Geneva: WHO Press; 2010.
13. Antibiotic Expert Group. Therapeutic guidelines: antibiotic. Version 15. Melbourne: Therapeutic Guidelines Limited; 2014.
14. National Health and Medical Research Council. *Australian Guidelines for the Prevention and Control of Infection in Healthcare*: Commonwealth of Australia; 2010.
15. National Tuberculosis Advisory Committee. Position statement on interferon- γ release assays in the detection of latent tuberculosis infection. *Commun Dis Intell* 2012;36(1):in press.
16. National Tuberculosis Advisory Committee. National Tuberculosis Advisory Committee Multi-drug resistant tuberculosis: information paper (October 2007). *Commun Dis Intell* 2007;31(4):406-409.

TB information and fact sheets are available on state and territory websites:

<http://ideas.health.vic.gov.au/diseases-complete-listing.asp#t>

<http://www.health.nsw.gov.au/publichealth/Infectious/a-z.asp#T>

<http://www.health.qld.gov.au/cdcg/index/default.asp#t>

http://www.health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx

<http://www.health.wa.gov.au/acc/home/>

National TB Advisory Committee website:

<http://www.health.gov.au/ntac>

14. Appendices

Appendix 1: Example of TB Investigation form

15. Jurisdiction specific issues

Links to State and Territory Public Health Legislation, the Quarantine Act and the National Health Security Act 2007.

<http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-state-legislation-links.htm>