CHAPTER 15

Drug resistance and infection control

15.1 Chapter objectives

This chapter addresses special considerations for reducing transmission of MDR-TB through infection control measures. Infection control practices are discussed in more detail in other WHO documents (*1*). Since every instance of transmission averted represents one less potential MDR-TB case, infection control needs to be a leading programmatic priority. It is equally important to protect health workers in the MDR-TB setting.

15.2 The priorities of infection control

MDR-TB is transmitted in the same manner as drug-susceptible TB. Well-documented outbreaks of highly drug-resistant TB constitute convincing evidence that MDR-TB is transmissible, especially among highly vulnerable populations and in institutional settings. Moreover, because MDR-TB patients may respond to treatment slowly and remain sputum smear-positive longer than other TB patients, they may infect more contacts.

The management of MDR-TB does not significantly alter the basic TB infection control strategies. However, in view of its seriousness, every programme attempting to treat MDR-TB should also undertake a systematic review of current practices and ensure that everything possible is done to prevent transmission among patients and to staff.

Recommendations for infection control to prevent MDR-TB are essentially the same as those to prevent the spread of drug-susceptible TB, with only minor differences in emphasis. Further information is provided in the WHO/CDC/IUATLD *Guidelines for prevention of tuberculosis in health care facilities in resource-limited settings* (*1*). This chapter reviews briefly the recommendations that have a specific focus on MDR-TB. (Additional recommendations for areas with high HIV prevalence are in preparation.)

TB infection control has three components. By order of importance, they are: administrative controls, environmental or engineering controls, and personal respiratory protection. The administrative controls are the most effective and least expensive and therefore have highest priority in resource-constrained settings.

15.2.1 Administrative controls

Administrative controls include policies and procedures intended to promptly identify infectious cases so that additional precautions can be taken. They necessitate the appointment of a director of infection control for the institution, and an infection control committee representing key departments of the facility. The initial task of the committee is the formulation of a comprehensive infection control plan for the institution, including a programme for the education of all staff on infection control policies and procedures.

An important aspect of administrative control measures is the physical separation of patients known or suspected to have TB or MDR-TB (especially smear-positive cases) from other patients, especially those who are immunocompromised. In many resource-limited settings, however, isolation rooms are not available and patients are mixed together in open wards. A second, less satisfactory but practical, solution is to separate rather than isolate patients. In this approach, patients with TB are grouped together and apart from those with suspected MDR-TB, who are grouped together. This separation may be difficult as wards are usually separated by sex, which increases the number of different areas required. The presence of a substantial number of HIV-infected patients further complicates separation as they are not only potentially infectious but also highly vulnerable to intercurrent infection and reinfection from others. Placing HIV-infected patients with known or suspected TB together with other TB or MDR-TB patients should always be avoided.

Another administrative issue is the length of time patients spend in the hospital. In many resource-limited countries, patients are traditionally treated for prolonged periods in the hospital, particularly when they come from great distances. However, this practice involves an increased risk of nosocomial transmission. The risk of transmission to patients and health-care workers decreases when community-based ambulatory treatment is established and hospital stays are reduced. Although most transmission is likely to have occurred before the diagnosis and start of treatment, ambulatory patients should be advised to avoid contact with the general public and with particularly susceptible people, such as young children or individuals with HIV infection. Health-care workers visiting TB patients at home before treatment is well established should wear properly fitted personal respirator masks.

15.2.2 Environmental controls

Environmental (or engineering) controls assume that unsuspected, untreated TB patients will enter hospitals despite all efforts to identify them. In addition, there are certain high-risk settings, such as sputum induction rooms, bronchoscopy rooms and rooms for the evaluation of newly admitted patients who may have untreated TB or MDR-TB, where engineering interventions are necessary to reduce risk. Engineering controls attempt to reduce the concentration of infectious droplet nuclei in the air. They include natural and/or

mechanical ventilation, ultraviolet germicidal irradiation (UVGI) and high-efficiency particulate air filtration. Environmental methods should never replace administrative controls; in fact, they work together.

In warm climates, infection control often depends on natural ventilation. The efficacy of natural ventilation has not been studied, but it probably depends heavily on climatic conditions. In warm climates, patients spend much of their time out of doors where transmission is highly unlikely. However, at night, for security and warmth, patients stay indoors with doors and windows usually closed tightly. Thus, patients in sub-Saharan Africa (warm climate) and in Siberia (cold climate) may endure similar high-risk conditions, at least some of the time.

The use of extraction fans to improve ventilation in closed rooms through wall vents can be extremely useful. Mechanical ventilation systems are uncommon in resource-poor settings and, when present, are often poorly maintained. However, a little ventilation is better than none, and in facilities with mechanical ventilation systems efforts should be made to ensure that they function correctly.

Ventilation can be supplemented with upper-room UVGI. This has long been known to be extremely effective in inactivating infectious particles in the air above people's heads, while not exposing them to skin or eye irritation, which is the only practical safety concern. Normal convection currents or low-velocity ceiling fans usually ensure good room air mixing, thereby decontaminating air in the breathing zone. Upper-room UVGI is intended for use while rooms are occupied, but not to sterilize empty rooms as is commonly done in some parts of the world. It is much more important to decontaminate air while the infectious source and other occupants are present, and upper-room UVGI is designed to do so without significant radiation risks.

A growing number of manufacturers of fixtures designed for upper-room use are established in low-income countries and can provide products at relatively low cost. However, there are currently no standards for these products; the buyer should obtain advice from an engineer knowledgeable in the field.

In addition to UVGI designed for upper-room use, germicidal UV is sometimes used in ventilation ducts or in fan-driven air sterilizing devices mounted on ceilings or walls, or portable units that can be moved from room to room. However, the efficacy of these systems is limited by the number of air turnovers they can produce, especially in large spaces. By irradiating large volumes of upper-room air at one time, upper-room systems have a quantitative advantage, especially when combined with low-velocity ceiling fans to ensure room air mixing.

Laboratories that process specimens that may be MDR-TB require particularly strict environmental controls. These aspects are addressed in other WHO documents and in Chapter 6 of these guidelines.

15.2.3 Personal respiratory protection (special masks)

Because administrative and engineering controls cannot provide complete protection, the third line of defence against nosocomial TB transmission is the use of personal respirators.

Personal respirators are fundamentally different from, and more expensive than, the more familiar surgical masks which they resemble. Surgical masks are designed to protect the operating field from relatively large respiratory droplets generated by surgeons and surgical nurses. They are relatively loose-fitting and made of paper or cloth; they are not adequate for prevention of TB infection.

Masks that prevent TB transmission are known as "particulate respirators" or simply "respirators". They are designed to protect the wearer from tiny (1–5 μm) airborne infectious droplets. The filtration media through which air passes must capture these minute particles; most importantly, the respirator must fit tightly on the face, especially around the bridge of the nose. Ideally, respirators should be "fit tested" for individual wearers. In addition to choosing the proper model for each worker, this process serves to educate workers on how to put on their respirators correctly to minimize face-seal leakage. Men with beards cannot be properly fitted with personal respirators. Institutions purchasing respirators are advised to look for models that are specifically designed to protect against TB and that meet international standards of quality.

Because they are visible and relatively expensive, it is sometimes assumed that personal respirators alone will prevent TB transmission. However, they cannot be worn continuously and are likely not to be in use when unsuspected TB cases, or unsuspected MDR-TB, are encountered. For these reasons, administrative controls that aim to detect and separate cases, and engineering controls that can reduce the risk even for unsuspected cases, are more important.

15.3 Role of rapid tests in infection control

The use of a rapid test for rifampicin or other drugs is an excellent method of distinguishing those who may have MDR-TB from others. Patients who are identified by rapid tests can be properly separated or isolated immediately (in addition to starting proper empirical regimens). Chapter 6 provides further information on rapid tests.

References

1. *Guidelines for the prevention of tuberculosis in health care facilities in resource limited settings*. Geneva, World Health Organization, 1999 (WHO/TB/99.269).
2. *Laboratory services in tuberculosis control. Parts I, II and III*. Geneva, World Health Organization, 1998 (WHO/TB/98.258).