TRIOLOGY

THE CLOCK IS TICKING:

END TUBERCULOSIS, AN EXISTING MICROBIAL THREAT

Figure 1. *Mycobacterium tuberculosis*

Active TB infection	Latent TB infection
The bacterial infection has overcome the body's immune system, multiplied, and spread to other parts of the body[3].	The immune system cannot kill the bacterial infection but has managed to prevent spread throughout other parts of the body[3,7].
Symptoms will develop within a few weeks or months[5].	May never develop TB disease, and the *M. tuberculosis* can remain inactive for a lifetime[7].
General symptoms include: A bad cough for three weeks or more[1]. Coughing up blood[1]. Sweating at night[1]. The patient usually feels ill[1].	Present no symptoms[5,7].
The patient is infectious and can spread TB to others[7] .	The patient is not infectious[7].
May have an abnormal chest x-ray, or positive sputum smear (the mucous secreted by cells in the lower airways of the respiratory tract) or culture[7].	A chest x-ray will appear normal and a sputum smear will be negative[7].
Usually have a positive skin test or blood test indicating TB infection[7].	Usually have a positive skin test or blood test indicating TB infection[7].
Will require treatment for active TB[7].	Will require treatment for latent TB infection to prevent TB from becoming active[7].

Table 1. Comparison of active and latent TB infections

WHAT IS TUBERCULOSIS?

Tuberculosis (TB) is an airborne bacterial infection caused by *Mycobacterium tuberculosis* (*M. tuberculosis*) (Figure 1.) that usually affects the lungs (known as pulmonary TB)[1,2]. TB can spread through the inhalation of respiratory droplets of an infected person[1,3]. **TB is a severe condition that can be fatal if not appropriately treated**[1].

Depending on the airflow in the environment, the respiratory droplets can remain suspended in the air for several hours unless removed by natural or mechanical ventilation[4]. Therefore, daily disinfection of surfaces with mycobactericidal agents is required, particularly in hospitals and clinics[4].

Did you know there are two types of pulmonary TB infections[3]?

In most people who inhale *M. tuberculosis*, the body's natural immune system can fight the TB infection[3]. As a result, not everyone infected with TB will become ill[3]. For those who cannot fight-off TB infection, there are two TB-related conditions that exist[3]:

- **Active TB** - Active TB infection refers to when the infection has overcome the body's immune system, multiplied, and spread to other parts of the body, causing symptoms[3,5].
- **Latent TB** - Latent TB infection refers to someone who is infected with *M. tuberculosis* but does not present with active TB symptoms and does not feel ill[3,5]. Latent TB can develop into active TB in people whose immune systems have been weakened over their lifetime or due to medical conditions[5]. Refer to table 1 for a comparison of the two TB-related conditions.

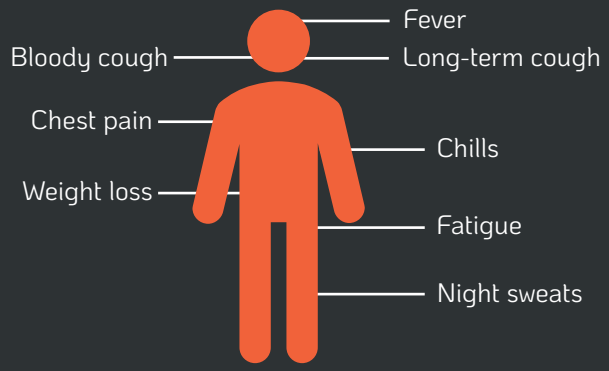
Did you know TB can also develop in other parts of the body[5]?

It is possible for TB infections to develop in areas outside the lungs (extrapulmonary TB)[5], such as in the lymph nodes, the bones and joints, the digestive system, the bladder, the reproductive system, and the nervous system[4]. Usually, TB infections in other parts of the body are not infectious[6] and are more common in people who have a weakened immune system[5].

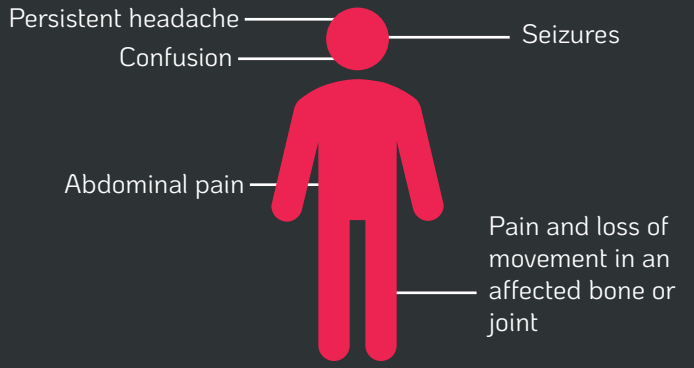
WHAT ARE THE MOST COMMON SYMPTOMS OF TB?

Did you know for active TB, the symptoms may be mild for many months leading to delays in seeking medical advice[1,5]? – This increases the probability of transmission to others[1].

Common Symptoms of Active Pulmonary TB [1,3,7]



Common Symptoms of Extrapulmonary TB[5]



WHO IS AT RISK?

All age groups and ethnicities are at risk of TB[1]. However, there are risk factors that increase the likelihood of contracting TB including:

- Working or residing with people at high risk for TB in facilities such as hospitals, nursing homes and homeless shelters[8].
- Underlying medical conditions in young children and immunocompromised individuals such as human immunodeficiency virus (HIV) and diabetes mellitus[8].
- Misusing alcohol and smoking tobacco[8].
- Recovering from active TB infection[8].
- Residing in crowded conditions[8].
- Residing in or visiting an area with high levels of TB[8].

WHY IS TB A MICROBIAL THREAT?

Did you know the COVID-19 pandemic could potentially cause an additional 6.3 million TB cases worldwide by 2025[9]?

The COVID-19 pandemic may reverse all progress made in ending TB[9]. The implementation of social distancing measures may help reduce TB transmission[9]. However, this could be offset by longer durations of infectiousness; increased likelihood of exposure to TB infection within the household; worsening outcomes due to a decrease in care-seeking behaviour of the infected and the extra pressure on health services; and higher levels of poverty, particularly among the most vulnerable populations where severe economic contractions and loss of income occurs[9]. COVID-19 has placed significant financial pressure on the availability of global funding commitments from governments for the TB response[9]. Several countries with resources initially allocated for TB have diverted the funds to the COVID-19 response for their citizens[9]. The combination of TB and COVID-19 effects on a person's respiratory and immune system could prove to be deadly.

Did you know only two in three people with drug-resistant TB have access to treatment[10]?

Multidrug-resistant TB (MDR-TB) has emerged as a global health crisis[11]. MDR-TB is the consequence of anti-TB medicine misuse, incorrect prescription, low-quality drugs, and patients prematurely stopping treatment[1]. MDR-TB patients will not respond to isoniazid and rifampicin, the two most potent first-line anti-TB drugs[10]. In this case, second-line TB drugs will be used to treat MDR-TB[1]. However, extensively drug-resistant TB (XDR-TB) has also emerged globally, where TB patients do not respond to the most effective second-line anti-TB drugs[1]. Although XDR-TB is challenging to treat, it is not impossible[10]. A third more severe drug resistance, known as totally drug-resistant TB (TDR-TB), has also developed, often leaving patients without further treatment options[10].

Did you know TB is the leading killer of people with HIV[8]?

TB co-infection with HIV can be a lethal combination to an infected individual[1]. People living with HIV are eighteen times more likely to develop active TB[1]. HIV weakens the immune system enabling the TB infection to thrive in the body[1]. On average, without proper treatment, about 45% of HIV-negative people with TB will die[1]. In comparison, nearly all HIV-positive people with TB will die[1]. People living with HIV are now dying because of TB, despite the advancements made to improve their quality-of-life[1].

THE CLOCK IS TICKING

Everyone is susceptible to TB[9]. People with TB can be found in every country and from all age groups[1]. Areas with the highest TB cases include India, Indonesia, China, the Philippines, Nigeria, Pakistan, Bangladesh, and South Africa[1,3]. It is estimated 4000 lives are lost daily, 12,000 lives lost monthly, and 1.5 million lost yearly due to TB[12].

Did you know about a quarter of people worldwide are infected with *M. tuberculosis* and are at risk of developing active TB[1,8]?

It is time to act by testing and treating latent and active TB infections[13]. It is time to speak up and eliminate the stigma associated with TB that may prevent people from seeking medical care[13]. This can be done by improving public education and awareness of TB[13].

The hope of having a world free of TB, leading to zero deaths, disease and suffering because of TB, is achievable. However, everyone will have a part to play in preventing the spread of TB worldwide.

POSITIVE STEPS TOWARDS ENDING THE GLOBAL TB PANDEMIC

- ✓ Over 20 years of TB treatment saved approximately 63 million lives globally [1,9].
- ✓ In 2019, 54 countries had a low TB incidence (<10 cases per population)[9].
- ✓ The World Health Organisation (WHO) European Region achieved a 31% TB incidence reduction rate, which almost reached the 2020 milestone[9].
- ✓ The WHO African Region has made progress in reducing the TB incidence rate (<19%)[9].
- ✓ In 2019, the number of people provided with TB preventative treatment increased to 4.1 million[9].
- ✓ 42 countries reported a 10% increase in people being treated for TB between 2017 and 2019[9].
- ✓ In 2019, 7.1 million people had access to TB care[9].
- ✓ In 2019, 1.04 million children were treated for TB[9].
- ✓ In 2019, 3.5 million people living with HIV received preventative TB treatment[9].
- ✓ Rapid detection methods for TB diagnosis appears robust[9]. As of August 2020, there were 22 drugs, various combination regimens and 14 vaccine candidates in clinical trials[9].
- ✓ Leaders of all UN Member States have committed to ending the global TB epidemic by 2030[1,9].

REASONS WHY TB REMAINS A GLOBAL CONCERN

- × TB is one of the top 10 causes of death worldwide and the leading killer from a single infectious agent[1,8,9].
- × In 2019, 10 million people fell ill with TB[1,9,10].
- × In 2019 1.4 million people died from TB[1,10] of which 208,000 were people living with HIV[1].
- × There is a lack of harmonised instructions in current guidelines establishing how disinfection should be implemented in functional areas under high time pressure (e.g., in endoscopy rooms)[4].
- × Over 95% of TB cases and deaths are in developing countries[1].
- × TB incidence is falling, but not fast enough to achieve the 2020 milestone of 20% incident reduction[1,9].
- × In 2019, 1.2 million children fell ill with TB globally. Child and adolescent TB is difficult to diagnose and treat. As a result, it is often overlooked by healthcare providers[1].
- × Underreporting and underdiagnosis of people with TB remains a significant challenge[10].
- × Every year an estimated 0.5 million people fall ill with drug-resistant TB[10,14].
- × In 2019, 30 high burden countries accounted for 87% of new TB cases[1,9].
- × The COVID-19 pandemic could reverse all progress to ending TB due to enforced lockdown and halt of business services[9].

Table 2. Highlighting positive steps towards eradicating TB and reasons why TB remains a global concern.

PROPRIETIES OF *M. TUBERCULOSIS*

Mycobacteria species have a unique cell wall and outer membrane composition, which includes: a thick peptidoglycan layer, lipopolysaccharides, embedded glycolipids, wax esters and mycolic acids (long fatty acids chains) that lend to the mycobacterial impermeable barrier[17,18]. The mycobacterial cell wall characteristics (Figure 2.) facilitate:

1. Survival in different environments, including biofilms, soils, and water[17,18].
2. Resistance to disinfection procedures as the waxy outer envelope can prevent disinfectant entry to the mycobacterial cell[17,18].

Did you know surfaces and medical devices can be a continuous source of transmission for pathogens such as *M. tuberculosis* if no regular preventative disinfection is performed?

M. tuberculosis can persist on surfaces for up to four months[19]. High-touch surfaces such as door handles, railings, chairs, and table tops may be potential transmission sources. Medical devices that make direct contact with the respiratory system, such as laryngoscopes, bronchoscopes, nasopharyngoscopes, gastrointestinal (GI) manometry catheters and transoesophageal probes, could all be carriers of *M. tuberculosis*.

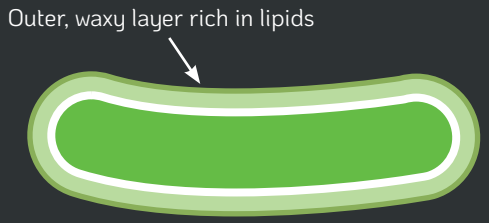


Figure 2. *M. tuberculosis* waxy cell envelope

AVAILABLE DIAGNOSIS AND TREATMENT

Diagnosis of TB for many countries is assessed by sputum (a mixture of saliva and mucous coughed up from the respiratory tract) smear microscopy[15]. This detection method involves trained laboratory technicians examining sputum samples under a microscope to determine if TB mycobacteria are present. However, this method detects only half the number of TB cases and cannot detect TB drug resistance[15].

Rapid molecular diagnostic tests have high diagnostic accuracy and are recommended by the WHO for anyone with signs and symptoms of TB, as the initial diagnostic test[1]. The rapid tests lead to significant improvements in the early detection of TB and MDR-TB[1]. Xpert MTB/RIF, Xpert Ultra, and Truenat assays are the rapid tests recommended by the WHO[1].

TB treatment typically involves the use of multiple medicines in a variety of combinations[16]. The combination will depend on the individual's circumstances. A first time TB infection will be treated differently from a reoccurring TB infection, and if a residential area is known to have antibiotic resistance to any TB drug treatment[16]. Active, drug-susceptible TB is a treatable and curable disease[1].

Typically, adherence to a standard six-month[3] course of four antimicrobial drugs and support for the patient by a healthcare worker or trained volunteer successfully facilitates recovery[9]. However, treatment adherence can be problematic for people with limited access to TB treatment facilities[9,16]. Those who have active MDR-TB contribute to the difficulty healthcare professionals have in successfully treating TB[9,16].

PREVENTION AND INFECTION CONTROL MEASURES

Health care interventions available to reduce the risk of TB include:

- Adherence to infection prevention – maintaining good hand hygiene and conducting disinfection of medical devices and surfaces that can be carriers of TB[4].
- Preventative TB treatment for latent TB infection[7].
- Implementing a global multisectoral approach on determinants such as poverty, housing quality and undernutrition to tackle TB[9].
- Encouraging the reduction in the prevalence of health-related risk factors for TB such as smoking, alcohol misuse, diabetes, and HIV infection, which can help decrease the number of TB related cases worldwide[1].
- BCG vaccination protects from severe TB in children, especially in countries with a high TB-burden and in households with people living with HIV[3].

Did you know people infected with TB can infect up to 15 other people through close contact over a year[1]?

If you have been diagnosed with TB, please follow your doctor's advice to limit the spread. Such advice may include:

- Ensure to take prescribed TB treatment as ineffective treatment can lead to transmission and antibiotic resistance[3].
- Ensure to cover the mouth with a tissue when coughing or sneezing and dispose of tissues carefully in a sealed bag[3].
- Ensure to wash hands regularly[3].
- Ensure to avoid large crowd gathering and public transportation[3].
- Do not return to work, school or college until the specialist has confirmed you are no longer infectious[3].

TRISTEL EFFICACY

Prevent the spread of TB and other pathogens by:

- Ensuring the surfaces in the vicinity of patients and staff are disinfected.
- Ensuring the device is high-level disinfected after each patient use.

Quaternary ammonium compounds (QACs) are less effective against mycobacteria, especially in the presence of protein residues, i.e., soiling.

QACs work by disrupting the cell wall, leading to the cytoplasm leaking out of the cell[21]. QACs mode of action is limited by the mycobacteria's waxy outer cell walls[21] (Figure 2.). This is because QAC active components are hindered from causing cell wall disruption to deactivate/destroy mycobacteria[21]. QACs are considered low or intermediate level disinfectants and may require long contact times to achieve the required efficacy level. A surface or device must remain visibly wet for the recommended product contact time during the disinfection process, or reapplication is required. This can be difficult to achieve, especially in the medical environment, where time constraints are critical to reducing patient waiting times and increasing patient turnaround. QACs are not recommended as high-level disinfectants due to their poor efficacy against mycobacteria and spores[22].

Tristel's high-level disinfecting chlorine dioxide-based products, offer a full spectrum of microbial efficacy including against *mycobacterium* species. Tristel chlorine dioxide-based products are mycobactericidal following the required European Norm (EN) test standards stipulated in EN 14885:2018.**Tristel products including Tristel Fuse for Stella (for use with Stella), the Tristel Trio Wipes System, JET and FUSE have been tested and are proven effective against *Mycobacterium terrae* and *Mycobacterium avium*.**

M. terrae is the surrogate species for *M. tuberculosis*, and as a result, it is acceptable for a product to claim tuberculocidal efficacy [against TB] when possessing this data. Efficacy against both *Mycobacterium* species, *M. terrae* and *M. avium*, enables a product to be termed 'mycobactericidal,' inferring efficacy against all *Mycobacterium* species.

USE TRISTEL CHLORINE DIOXIDE PRODUCTS TO PROTECT YOUR DEVICES AND SURFACES

STELLA

Quick, mobile, and economic reprocessing of single-lumened and non-lumened, heat-sensitive medical devices.
5-minute contact time.

TRISTEL TRIO WIPES SYSTEM

A comprehensive solution for the decontamination of semi-critical, non-lumened medical devices.
30-second contact time.

JET

A sporicidal disinfectant foam, ideal for use on high-touch surfaces.
1-minute contact time.

FUSE

A sporicidal disinfectant solution designed for use on large surface areas such as floors and walls.
5-minute contact time.

TRIOLOGY

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For Tristel patent information please visit: http://www.our-patents.info/tristel

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