

Nontuberculous Mycobacteria (NTM)

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Bacteria, like plants and animals, have been classified into similar groups. The groups are called "families." One such family of bacteria is known as the *Mycobacteriaceae*. Within this family there are a number of species. Some species can cause human diseases (pathogenic). Other species do not cause human diseases (saprophytic).

For example, *Mycobacterium tuberculosis* is an infamous species. This is the organism that causes human tuberculosis. *Mycobacterium leprae* is the organism that causes leprosy.



What is the Difference between TB and NTM?

Nontuberculous mycobacteria (NTM) refers to all the species in the family of mycobacteria that may cause human disease, but do not cause tuberculosis (TB) or leprosy. In a U.S. study from 2010, it was estimated that approximately 30 people per 100,000 population were infected with these lesser-known "cousins" of TB and leprosy. In fact, for unknown reasons, data from across the globe note an increase in case rates of infection over time.

M. avium complex is the most common NTM to cause human infection in the U.S., and it makes up around 80 percent of the infections we treat at National Jewish Health. It is often referred to as MAC. It was formerly thought to be made up of two species, *M. avium* and *M. intracellulare*. With more sophisticated tools, we appreciate that there are at least 10 different species within this complex. The three main species to cause disease are *M. avium*, *M. intracellulare* and *M. chimaera*.

Unlike tuberculosis (TB), which is spread from person to person, nontuberculous mycobacteria (NTM) infections are not considered contagious. How and why people become infected with NTM is not clear. The nontuberculous mycobacteria (NTM) causes are still under investigation.

Although the bacteria is found easily in water and soil, they do not affect most people. Doctors believe that some people who become infected have an unknown defect in their lung structure or function or in their immune systems. People who have damaged lung tissue from diseases such as emphysema, bronchiectasis, adult cystic fibrosis or previous infection appear to be at greater risk for developing a NTM infection. People who have a suppressed immune system, such as those who receive strong immunosuppressant medications like prednisone or newer immunosuppressants like TNF inhibitors, have a greater risk of developing an NTM infection. The infection may affect all organs of the body, not just the lungs. People with AIDS may also develop NTM infections.

There are studies that have shown a higher burden of infection in states with higher water vapor content. There is also supportive evidence for people acquiring the infection from their local water supply. In considering an apparent increase in the number of NTM lung disease seen over the past 25 years, it has been noted by researchers in the field that NTM are commonly recovered from home water systems.

There are several theories regarding the increasing incidence of infection. One relates to showering rather than bathing in a tub. Showering in a closed stall exposes the user to a higher aerosol concentration of NTM. In addition, to save energy, water heaters have lower temperatures now, which could allow more NTM growth in the water. The materials used in homes may be more supportive for biofilm growth, which is a hospitable environment for these organisms to grow. Water filters are now used in most homes. They remove the organic compounds that make our water taste bad, but they do not filter out mycobacteria. In fact, the filters themselves may serve as a breeding ground for organisms and allow for higher concentrations of mycobacteria compared to unfiltered water. Finally, there are data to indicate that aspiration of water, either through swallowing or gastroesophageal reflux, is a way that mycobacteria gain access to the lungs to cause disease.

What are the Different Types of NTM?

Under the microscope, nontuberculous mycobacteria and tuberculosis appear quite similar. Careful lab studies must be performed to tell them apart. Most labs are capable of distinguishing between tuberculosis and non-tuberculous mycobacteria. Interestingly, there are more than 170 different species of NTM. Fewer labs are equipped to determine exactly which NTM organism it might be and its susceptibility to antibiotics. This is important to determine the best treatment.

The importance of identifying the exact organism can be illustrated with two of the organisms, *Mycobacterium gordonae* and *Mycobacterium scrofulaceum*. These two are very similar and react the same way in many lab tests. However, they react in different ways in the human body. One organism causes disease; the other organism does not cause disease. In this case, if the organism turns out to be *M. gordonae*, treatment is seldom indicated. *M. gordonae* is often a lab contaminant and not a cause of human disease. In fact, *M. gordonae* is found in water supplies so often that it is nicknamed "the tap water bacillus." *M. scrofulaceum*, on the other hand, is known to cause disease and may require specific forms of treatment.

Other NTM species that may require treatment include: *M. avium complex*, *M. kansasii*, *M. abscessus*, *M. chelonae*, *M. fortuitum*, *M. terrae*, *M. xenopi*, *M. simiae*, *M. szulgai* and *M. malmoense*. Among the NTM, there are three species that predominantly involve the skin: *M. leprae*, *M. ulcerans* and *M. marinum*.

What are the Symptoms of an NTM Infection?

Like tuberculosis (TB), nontuberculous mycobacteria (NTM) infection often affects the lungs. Therefore, nontuberculous mycobacteria symptoms are similar. Most NTM infections and resulting symptoms progress slowly. Some people may have had this infection for years before they are diagnosed. Symptoms may include:

- Fever
- Weight loss
- Cough
- Lack of appetite
- Night sweats
- Blood in the sputum (hemoptysis)
- Loss of energy
- Shortness of breath

Rarely, people will have no symptoms, and the infection is discovered when chest imaging is ordered for other reasons. In these people, we would strongly recommend observation before launching into a complicated treatment regimen. The fever is often low grade. Throughout history, tuberculosis was also described as "consumption." The same phenomena can occur with

NTM infection. Cough is a common complaint and can be either “dry” or “productive” of sputum. The color of the sputum is not helpful in the diagnosis. Night sweats may be mild or drenching. Blood in the sputum is unusual unless there is cavity formation (holes within the lung tissue) or severe bronchiectasis (dilation of the airways). Loss of energy is also described as fatigue, and this is a difficult symptom to quantify. Some people notice they don’t have the energy to do all the activities they used to do. Some people have to take naps to get through the day. Shortness of breath may occur, but it is not universal. It may be related to an underlying lung disease, such as emphysema, which is exacerbated by the infection or simply by the infection itself.

How is an NTM Infection Diagnosed?

A nontuberculous mycobacterial (NTM) diagnosis can be more difficult to establish than a tuberculosis (TB) diagnosis. It is important for your health care provider to determine if the infection is TB or NTM because the treatment is different. If it is NTM, the specific species of NTM is also important. Because these organisms are abundant in the environment, we require more than one positive sample to be consistent with disease. In addition, it is critical for the health care provider to determine whether the NTM infection requires treatment. Some people harbor the germs and remain well. They may need to be observed without treatment. Others develop symptoms consistent with progressive illness. A diagnosis is often based on the following:

- A complete medical history and physical examination by a health care provider (often a pulmonary doctor).
 - A Chest CT scan (a specialized X-ray, which produces detailed slide-like pictures) of the lungs.
 - A sputum culture. Several sputum cultures are often necessary and must be done at specialized labs. One positive test does not always mean disease is present. In people that are not productive on their own, we strongly encourage a sputum “induction” (using hypertonic saline) before proceeding to bronchoscopy.
 - Other procedures, such as bronchoscopy, may be required in certain cases.
 - Based on the results of the tests your doctor can determine a diagnosis and the best treatment for you.
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What is the Treatment of NTM?

There are different goals of therapy. Of course, the most important goal is cure. Depending on the species, that may be possible. Cure is defined by a microbiologic outcome. If sputum cultures become negative and remain negative after treatment that is a microbiologic cure. We also follow clinical symptoms and anticipate that treatment results in resolution of fevers, night sweats, cough, etc. finally, we follow imaging (CT scans of the chest) while on treatment. We monitor for improvement in nodularity, closure of cavities and decrease in inflammation.

Most of the nontuberculous mycobacteria are naturally resistant to common antibiotics. The treatment regimens recommended vary greatly depending on the species. Some of medications used to treat NTM happen to treat tuberculosis (TB) as well. To overcome drug resistance, people with NTM may need to take several different antibiotics at the same time. Typically, the regimen includes three antibiotics. Because these medications may have side effects, close monitoring is important. Furthermore, treatment may be necessary for as long as two years. The goal of treatment is to achieve “negative” sputum cultures and maintain that for 12 months before stopping. Sometimes treatment is ongoing, depending on the severity of the disease.

The most common organisms involved in human infection are *M. avium complex*, *M. kansasii* and *M. abscessus*. *M. kansasii* is easier to treat and often can be killed with only three anti-TB medications. On the other hand, organisms such as *M. avium complex*, *M. chelonae* and *M. abscessus* are among the most stubborn germs. They are more difficult to treat. Three to five medications may be needed. Depending on how localized the disease is, surgery also may be helpful.

Living with NTM Infections

Living with a *nontuberculous mycobacteria* (NTM) infection presents unique challenges. The symptoms of NTM, as well as the long course of treatment for NTM, can take a toll on a person's state of well being. Anxiety, depression, and fear of the future can all accompany a diagnosis of NTM and its treatment. People with NTM are often bewildered and lonely.

The good news is that you are not the first, nor the only person who suffers from an NTM infection. In fact, there are lots of people who have had NTM, and who are still infected with NTM, that are involved in support groups to help each other. Becoming involved in a support group can help alleviate the fear and anxiety you may feel. Discussing the special challenges that NTM poses with other people like you can be extremely helpful.

Visit our website for more information about support groups, clinical trials and lifestyle information.

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