



This presentation covers tuberculosis, a disease which is devastating. It is one that you can only address if you know the local language and have a long-term commitment to your location.

In Timbuktu tuberculosis kills.



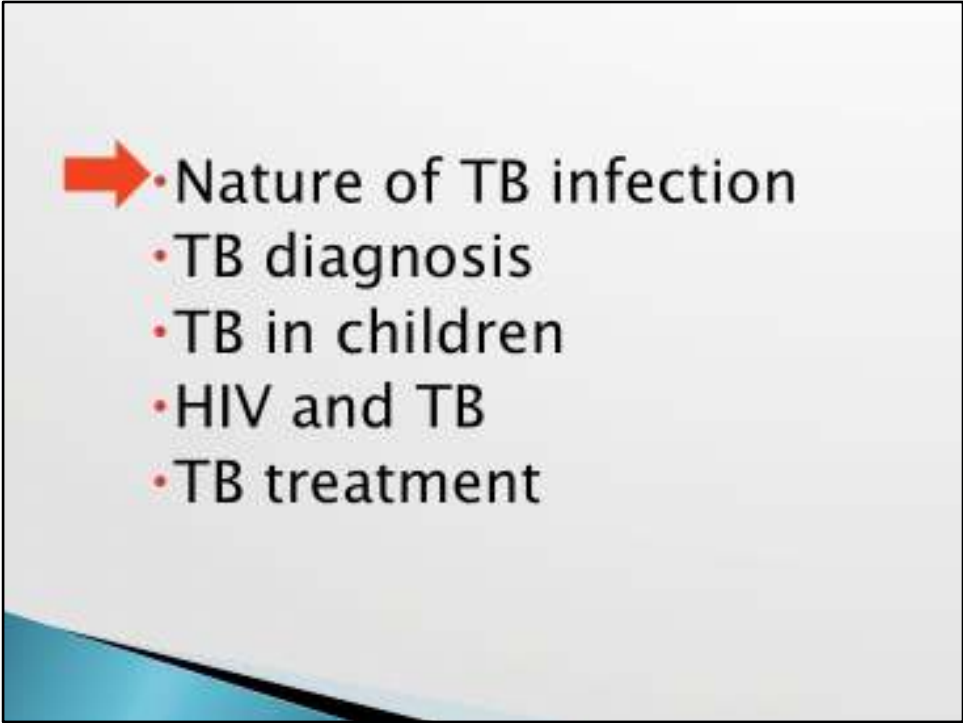
Each year millions of people worldwide become infected with tuberculosis. Many develop overt disease and many die. Poverty, over-crowding, an urban environment, and malnutrition all play a part in encouraging the propagation of tuberculosis. When you arrive in your Timbuktu, take note if there are people around who are extremely thin and have a chronic cough. If you find a number of people like this, suspect tuberculosis.

You need to pursue the culprit.



Art Explosion

The more untreated tuberculous patients there are, the more new infections there will be. You need to effectively treat a large percentage of the contagious individuals in order to break the cycle of infection in the community.

- 
- ➔ • Nature of TB infection
  - TB diagnosis
  - TB in children
  - HIV and TB
  - TB treatment

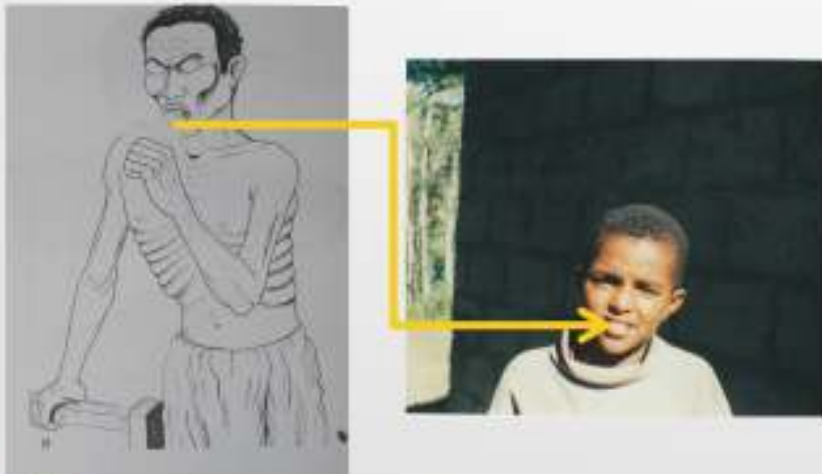
First we will consider the nature of TB infection.

## Understand tuberculosis.



It is important to understand how TB is transmitted from one person to another, and how the disease develops in those who are infected. In particular, it is essential to understand the myriad of presenting symptoms of tuberculous patients.

Infection = germs enter body.



When a tuberculous patient coughs or sneezes, millions of TB bacteria are scattered into his environment on water droplets. A healthy person then breathes in or swallows these bacteria. If there are just a few of them, the body's natural defenses eliminate the bacteria before they have time to set up housekeeping.

Germs enter the respiratory tract.



Art Explosion

If the germs are not eliminated by the defenses in the nose or mouth, then they usually enter the respiratory tract. Sometimes it's the digestive tract instead. Here the germs encounter additional body defenses.

Sometimes that is where it ends.



If the additional defenses eliminate the TB germs, that's the end of the story. The person develops no symptoms and does not become ill. He does not know that he is infected.





Infection is not the same as disease. Infection implies that germs are present in the body. Disease implies that those germs are making the patient ill.

Bacteria that make it past the upper respiratory track cause infection. When infection occurs, the body detects foreign matter. Then the immune system kicks in. When the immune system kicks in, the person's tuberculosis skin test changes from negative to positive. He has a tuberculosis infection but, at this point, he does not have the disease.

Disease = germs do damage.



Disease occurs when germs multiply and cause damage. If this happens, then the person becomes ill. Usually he will have a fever off and on, and possibly night sweats.

The chest lymph nodes fight TB.



In the process of fighting the TB bacteria, the lymph nodes enlarge. The red arrow points to large lymph nodes in the center part of the chest. These enlarged lymph nodes can be detected with a stethoscope, given a little coaching and experience.

## The nodes might win or lose.

Only large lymph nodes



TB spread all over lungs



Sometimes the process stops at his point, and sometimes it progresses to a localized infection or a whole-body infection. A localized infection is most often in the lungs, but it may occur in nearly any organ of the body. A whole-body infection is called miliary TB, because there are little infected lymph nodes that look like millet seeds scattered throughout the body.

Miliary disease is widespread.



Although it is widespread, miliary TB is not contagious, since there are no lung cavities. The disease is usually so overwhelming that the TB skin test is usually negative. The sputum will not show the TB bacteria.

## Tuberculosis affects adults.



The majority of TB cases are in adults. This presentation discusses adults and children separately, because the manifestations of TB are different in the different age groups.

Adults get lung cavities.



Before the HIV era, the vast majority of TB cases involved the lungs only. TB causes holes or cavities in the lungs. These cavities have TB pus in them which is expelled through the mouth and nose with coughing and sneezing.

## Cavitary disease is contagious.



Only older children and adults get cavities in their lungs, and they are the only contagious ones. Most TB in children is not contagious.



Young adults get scrofula.

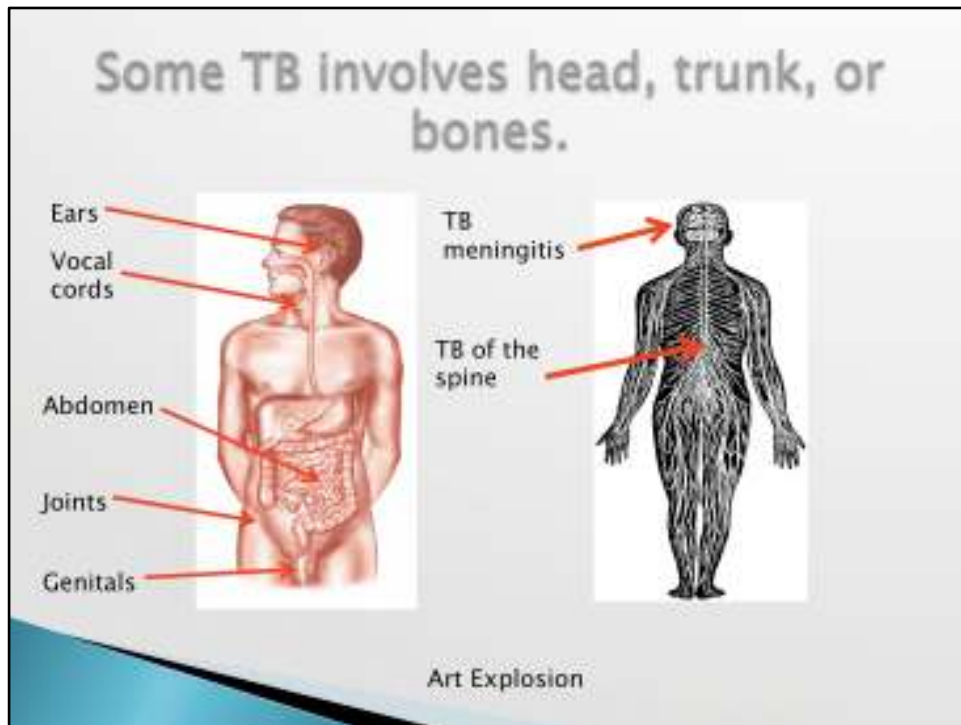


Scrofula is TB that has infected the lymph nodes of the neck, causing them to enlarge. Usually the patient does not also have lung TB. He may not feel generally ill.

Sometimes old ones do too.

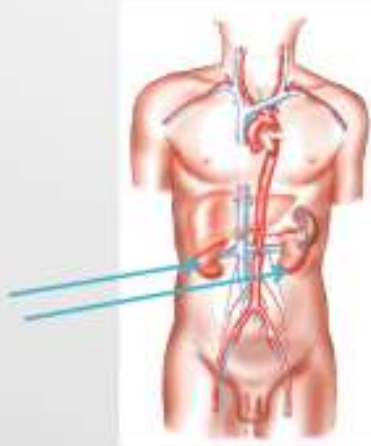


This lady's primary problem is lung TB which spread up to her neck. You can see the discolored skin and evidence that the scrofula has broken open. The white flakes are dried secretions that came from the infected lymph nodes. When scrofula breaks open there is almost always an odor of stale beer if you put your nose right next to the skin. It can be subtle. The odor makes the diagnosis of TB.



TB can involve almost any organ of the body. The majority of patients with lung TB have only lung TB. The majority of patients with non-lung TB have only non-lung TB. However, a significant minority of patients have both lung TB and other TB. The only contagious TB is cavitary lung TB in older children and adults. All other kinds of TB, both lung and non-lung, are not contagious.

The kidneys may become infected.



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If tuberculosis infects the kidneys, it causes episodic bloody urine. Most often the blood is in such a small amount that it can only be detected with a urine dipstick. The patient may have burning with urination. He or she seems to have a urinary tract infection that does not respond to the usual drugs and never totally goes away.

The abdomen swells and hurts.



Abdominal TB might arise from lung TB if the patient swallows his tuberculous sputum. It might also arise from eating TB-contaminated food. There are various manifestations of abdominal TB, but the most common is fluid in the abdomen, causing the patient to look pregnant.

TB may affect the bones.

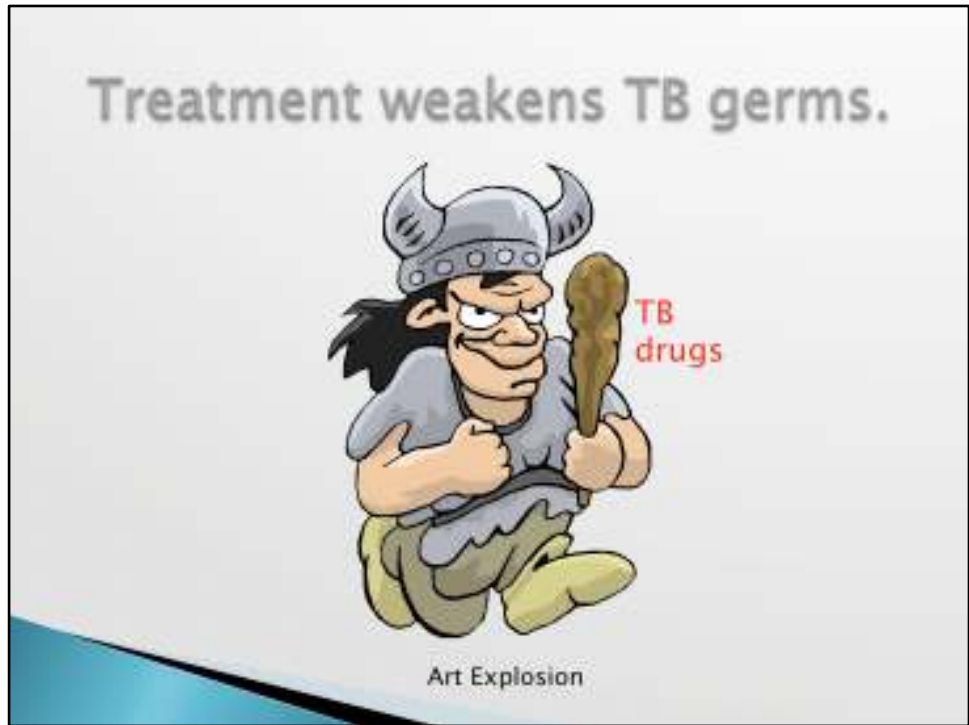


The backbone is the most common bone affected. The vertebrae collapse causing the backbone to stick out in back, as this young man's does. Sometimes the patient develops weakness and paralysis with very little backbone deformity. Sometimes the deformity, as it is here, is massive before weakness and paralysis develop.

TB may break through the chest wall.

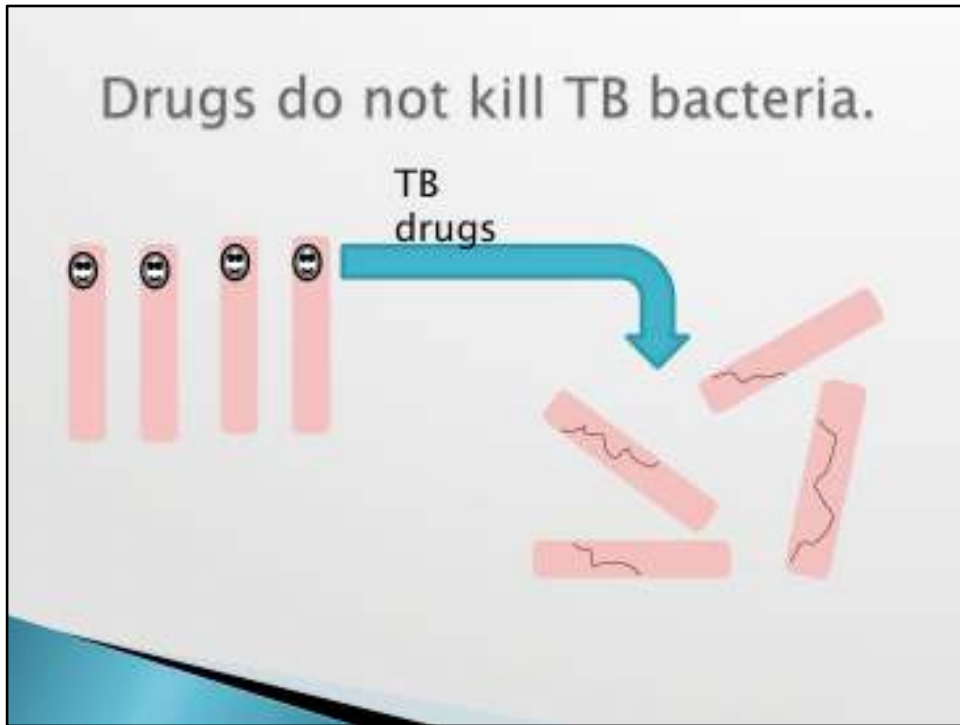


As TB causes lung infection, it might break through the chest wall, spilling pus. It is not unusual to find abscesses that are not tender and not warm to the touch on the chest wall in TB patients.

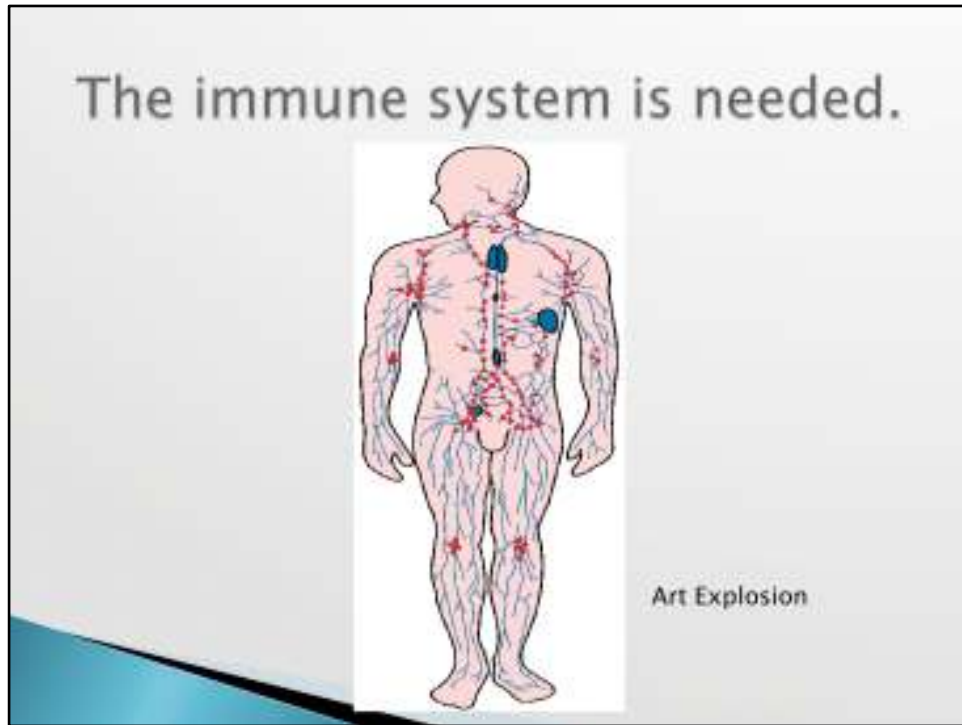


If and when the body is overwhelmed with TB, the only hope of survival is to tip the balance with TB drugs. In the early stages of TB, sometimes fresh air at high altitude and a nutritious diet might be helpful. Before the era of TB drugs, about half of lung TB patients survived with just such supportive treatment.





In contrast to some other antibiotics, TB drugs only weaken bacteria. They do not kill them.



A healthy immune system is necessary to contain and reverse the disease process. When the immune system weakens, then old TB is likely to relapse.

Now it's your turn.

- ▶ “This doctor must be crazy. He says my mother’s lungs are full of TB. Yet he insists that she is not contagious. He says she can cook for us.”

(Pause but do not read the slide script.) Discuss this quotation with your group. Then offer your comments.

The mother may have miliary TB. This is widespread throughout the lungs, but it is not contagious.

Your turn again.

- ▶ “My 2 year old niece got TB from her uncle, so obviously he was contagious. Now her mother wants me to take care of her next weekend. Is that safe?”

(Pause but do not read the slide script) Discuss this quotation with your group. Then offer comments.

Yes, it is safe. Tuberculosis in a 2 year old is not contagious. Young children do not get cavitory TB. It is only cavitory TB that is contagious.

And again.

- ▶ “Tuberculosis is a lung disease. My lungs are fine. How could TB possibly cause my low back pain?”

(Pause but do not read the slide aloud.) Discuss this with your group and then share your thoughts.

TB is not ONLY a lung disease. It can infect bone also. Having back pain due to TB is quite possible. The majority of non-lung TB patients don't also have lung TB.

Are there any questions so far?



One of the problems with diagnosing and treating tuberculosis is that there is no one nifty test that is both sensitive and specific. You should recall that a test would be sensitive for tuberculosis if nearly everyone who had tuberculosis also had a positive test result. A test would be specific for tuberculosis if a positive result could only be caused by TB, not by some other disease.

Since there are no sensitive and specific tests, you need to weigh the evidence from the medical history, physical exam, and the limited tests available. The decision process is complex, something like a high-profile jury trial.

These are the main tests.

- ▶ Chest X-ray: + = lung damage
- ▶ Sputum stain: + = contagious
- ▶ Skin test: + = infection

Chest x-rays only show damage to the lungs and surrounding structures. You can have a normal x-ray with TB or an abnormal x-ray without TB.

A sputum stain looks for TB bacteria in the lung secretions. If there are TB bacteria in the sputum, the patient is contagious.

The skin test turns positive very early on, if the patient has only infection, without any illness at all. The test is neither sensitive nor specific. If the disease is just starting or if it is totally overwhelming, in either case the test is likely to be negative.



Chest x-ray is not sensitive or specific.



Tuberculosis must be quite advanced before the chest x-ray becomes abnormal at all; the test is not sensitive. There are many diseases that can cause an abnormal chest x-ray. Tuberculosis is only one of these diseases. Therefore the chest x-ray is not specific. In spite of the test being neither sensitive nor specific, it is helpful at times. If it shows something resembling TB and the patient has a compatible illness, it can be a strong vote in favor of the diagnosis.

Sputum stain is not sensitive, but it is specific.



- ▶ Cold method: very insensitive
- ▶ Hot method: dangerous

CDC Public Health Image Library

The sputum stain is reasonably specific if it is done carefully with clean slides. This photograph shows the TB bacteria—the chains of pink dots. There are two methods for doing the sputum stain: the cold method and the hot method. The cold method, as the name implies, involves staining the slide without the aid of heat. It is by far the less sensitive of the two methods. The number of bacteria in the sputum must be overwhelming before it becomes positive at all.

The hot method, while more sensitive, involves heating the slides as they are stained. It is dangerous to do. The solvent for the stain is prone to catch on fire. Hence, the hot method is rarely used except in reference laboratories with excellent facilities and safeguards.

## Skin tests show the body's fighting TB.



CDC Public Health Image Library

The skin test turns from negative to positive if the patient's body is in the process of fighting tuberculosis germs. A positive skin test does not mean that the patient's current illness is due to TB. It simply means that he has been exposed to TB sometime in the past. Another cause of a positive skin test is that the patient may have been immunized with BCG. Many countries immunize babies at birth with BCG. It gives partial protection against TB and it turns the skin test positive. In countries where TB is unusual, it is better to skip the BCG. In countries where TB is common, the skin test is useless anyway, so then the partial protection afforded by BCG is valuable.

If his current illness is tuberculosis but his body's immune system is lying down on the job, not fighting the disease, then his skin test will be negative again. This happens with overwhelming infections, with old age, and in the presence of cancer or HIV infection.

Now it's your turn.

- ▶ “I’m keeping Johnnie home from school. His teacher’s arm was swollen from a TB skin test. I don’t want him to get sick.”

(Pause but do not read the slide text.) Discuss this with your group and then comment.

Johnnie needn’t stay home from school. A positive TB skin test just implies infection; it does not imply that the teacher has the disease.

Your turn again.

- ▶ “The patient had TB bacteria in his sputum, but his skin test was negative. The sputum stain must be wrong.”

(Pause but do not read the slide aloud.) Discuss this with your group. Then comment.

The patient may be old or have cancer or HIV. His body's immune system is lying down on the job, not fighting anymore. He's in a bad way, and he's contagious.

- Nature of TB infection
- TB diagnosis
- • TB in children
- HIV and TB
- TB treatment

Children are not just little adults. The manifestations of disease, of TB in particular, is qualitatively different in children. In this case, we consider children to be only those under age 10. Children 10 years and more get adult-type tuberculosis.

Children get TB from adults.



Since adults generally are contagious and children are not, children get their TB infections from adults but not vice versa.

Preschoolers are rarely contagious.



Since preschoolers don't develop cavities in their lungs, their secretions are not infective for others.



5-10 year olds are almost exempt.



One can see TB in the 5-10 year age range, but it rarely starts then. It might start at a younger age and continue during the lower grade-school years.

Some cases are disseminated.



CDC Public Health Image Library

In some children, TB affects not only the lungs but the whole body.

TB causes failure to thrive.



Children lose their appetites. They lose weight, and don't want to play. Black hair turns blond and blond hair turns dark.

Many cases involve the lungs.



Lung TB in children usually involves the entire lungs. The typical scenario in a tuberculous child is failure to thrive plus the lungs sound awful through the stethoscope throughout the entire chest: front, back, left, right, top, bottom. Many times one can detect large chest lymph nodes by stethoscope also. With most other lung diseases, the abnormal sounds are confined to one portion of the child's chest.

TB causes abdominal swelling.



The books say that abdominal TB is mostly a middle-aged adult disease, but in my experience it is very common in children, particularly in the 8-14 year range and among males. This photograph shows an extreme case. With abdominal TB, the patient has an abdomen full of fluid, but his legs and feet are not swollen. His urine tests negative for bilirubin, thus excluding liver disease as a cause of the swelling. If the abdominal wall is not too tense, you can feel a myriad of tiny lumps in his abdomen; it is like feeling a beanbag or a plastic bag full of split peas.

With treatment, the patient as a whole responds to medications quite rapidly. However, the swelling disappears only slowly, over months.

## TB causes bone problems.



When TB in children affects the bones, it is usually the spine or else a single joint of the lower limbs, such as a hip or a knee. The patient starts to walk with a limp. This child had TB in his lower back. It tilted his pelvis so one leg was longer than the other. He walked with a limp.

Now it's your turn.

- ▶ “This malnourished child just won't gain weight. We've tried everything. She has no cough, so the problem couldn't be due to TB.”

(Pause but do not read the slide.) Discuss this with your group, and then offer your thoughts.

Yes, it could be due to TB. Failure to thrive with no other cause is frequently due to TB.

Your turn again.

- ▶ “This man, his wife, and all their children have TB. I wonder who got it first and spread it to the others.”

(Pause but do not read the slide.) Discuss this with your group and then offer an answer.

One of the adults got it first. Inquire into the health of the grandparents. If they died, find out what their terminal illnesses were like. You will likely find that one of them had a chronic cough.



Are there questions about TB in children?

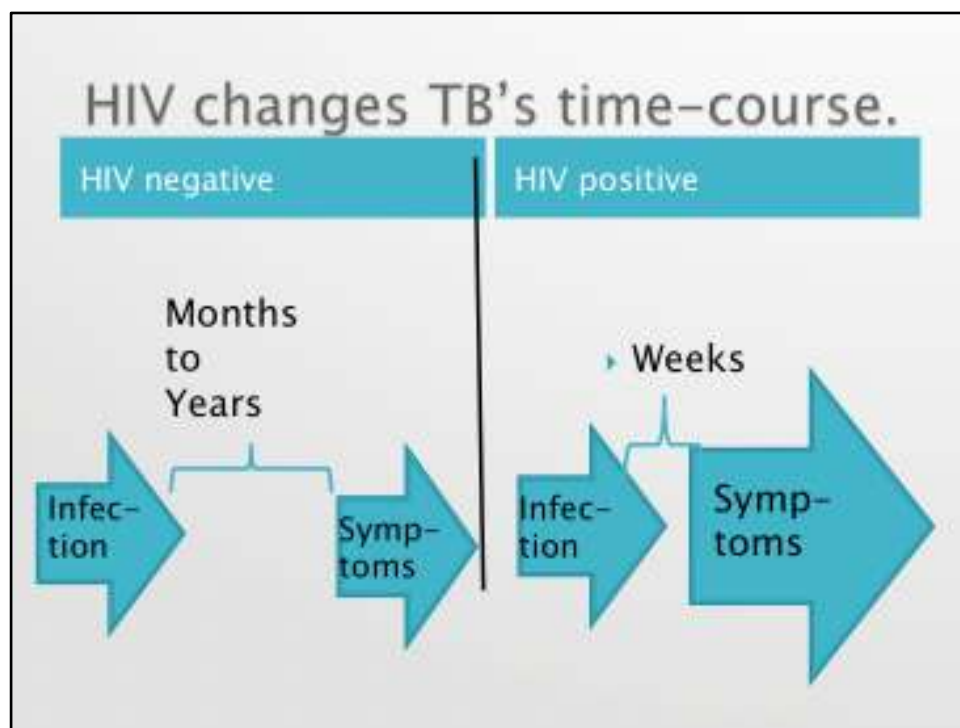
- Nature of TB infection
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HIV and TB together make a devastating duo. Co-infection with these two is becoming rampant worldwide. This is because HIV specifically devastates the portion of the immune system that is most important for fighting TB.

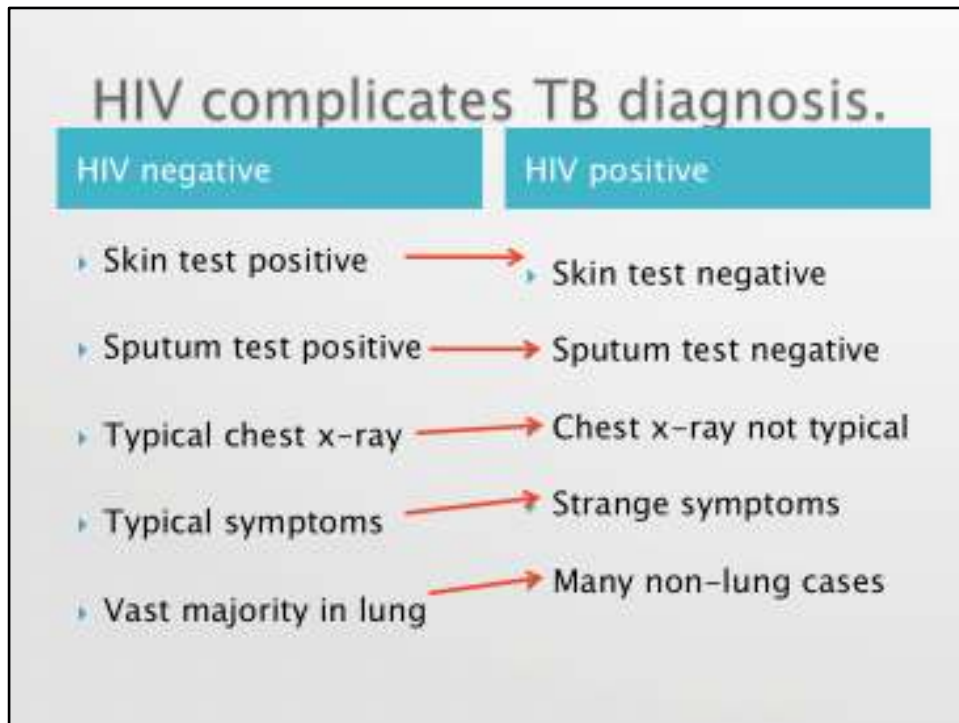
## HIV infection complicates adult TB.



HIV and TB cause a lot of the same symptoms. HIV makes TB worse and TB makes HIV infection worse. Moreover, patients with dual infections tend to have contagious TB and tend to stay contagious for much longer. They may still be contagious after a year of treatment. Patients who are HIV negative are usually not contagious after a month or two of treatment.




One of the hallmarks of tuberculosis, in contrast to other infections, is its long incubation and slow onset. In the presence of HIV infection the incubation and onset is markedly shortened. Also, once symptoms start, they tend to be more severe and progress much more rapidly.




On the left are listed the usual characteristics of TB in the absence of HIV. On the right are those in the presence of HIV.

HIV infection changes all the usual criteria for diagnosing TB. Given your situation in Timbuktu, sorting this out is hopeless. Unless you have great professional backup, it is probably best to simply put dually infected people in isolation until they die. You still need to identify these people and elicit the help of the local authorities to enforce their isolation.

HIV complicates TB treatment.

▶ Rifampin 

▶ Thiacetazone 

Patients who are taking HIV drugs should not take rifampin, one of the mainstays of anti-tuberculous treatment. The reason is that the rifampin nullifies the HIV drugs, rendering them useless. Another mainstay drug in developing countries is thiacetazone. Patients with HIV infections tend to get very nasty and sometimes life-threatening side effects with thiacetazone.

## HIV treatment may worsen TB.



Photograph Keith Effler

One of the reasons that HIV affects TB so much is because HIV disables the immune system needed to fight the TB germs. Nevertheless, when immunity suddenly increases, TB symptoms might suddenly worsen. This happens when a tuberculous patient starts on anti-HIV drugs. This phenomenon is called IRIS, which stands for immune reconstitution inflammatory syndrome. It is a good reason for you not to treat HIV patients for TB, or allow your TB patients to start HIV drugs. IRIS is too difficult for you to handle.

Now it's your turn.

- ▶ “This patient could not possibly have TB. He developed this abdominal pain over 10 days. His cough and weight loss are just due to his AIDS.”

(Pause but do not read the slide aloud.) Discuss this with your group and then submit a comment.

It could be TB. Moreover, he could be contagious. All bets are off on the usual time-course of TB in the presence of AIDS.



Your turn again.

- ▶ “We can eliminate TB as a possibility. His chest x-ray is abnormal but not typical of TB. His sputum test is negative and his skin test is negative.”

(Pause but do not read the slide script.) Discuss this with your group. Then comment.

He very well could have TB. His chest x-ray with dual HIV and TB infection may be atypical. His sputum and skin tests may very well be negative in the presence of HIV and TB dual infection. Moreover, he may be contagious in spite of a negative sputum. Keep your distance.

And one more.

- ▶ “I have a limited supply of TB drugs. Which TB patients should I NOT treat? I have to refuse some of them.”

Do not read the slide, but pause for your students to do so.

It is reasonable to refuse to treat patients that are HIV positive. However, if you do, you should put them in isolation so they do not infect other people. HIV positive patients consume an inordinate amount of TB drugs, and they are apt to develop complications that you cannot handle.

- Nature of TB infection
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We will consider just a few principles of TB treatment. There are detailed directions in the medical manual.

Treatment is complex, long, and expensive.



It would be so nice if a single injection would eliminate TB, but that is not the case. It is a difficult disease to treat under the best of circumstances. Since the HIV epidemic started, it is even harder to treat. Political considerations complicate the treatment a hundredfold. There are no easy answers. However, there are a few principles to consider.

## First decide whether to treat.



Photograph Keith Effler

First, you need to come to terms with the fact that you cannot treat everyone. You need to think through priorities as to where your limited supply of resources will do the most good. Assuming that you must pick and choose patients to treat, TB in a cancer patient should not be treated. TB in a patient with AIDS should not be treated. However, if the patient is contagious, he should be isolated, living in a separate room or house. You will probably choose to treat TB in young parents with dependent children rather than in grandparents. You will also choose to treat TB in children, where a life saved is many years saved.

Maximize numbers of lives saved.



It is better to treat all TB patients residing in a small geographical area than to treat everyone who shows up from a larger area. You can also maximize the numbers of lives saved by tracking down adult patients with cavitary disease and forcing them to accept treatment. Each such patient, on the average, infects 10 new people a year. You can give lower priority to patients with non-cavitary disease who aren't motivated to accept treatment. In rural areas, young people with scrofula do not merit treatment. Being uneducated, they will not understand the importance of taking drugs the whole 6 months. Their concern is to look nice. Once the scrofula disappears they will default, maximizing their chances of getting and spreading resistant TB later in life.

Maximize years of life saved.



Young people should be given preference over old people, other factors being equal. There are exceptions. If the death of an old person in a critical position will lead to the deaths of multiple others, then one's priorities might change. This granny is holding together her whole family. Her son and his wife died. She is essential to the long-term welfare of three dependent children.

Minimize wastage and expense.



You can minimize wastage by realizing that expiration dates can be ignored to some extent. Generally you can double the length of time from manufacture to expiration without doing your patients any harm. Beware of drugs manufactured in India and China. Many of the drugs from these areas are substandard or even fake. Using them might be worse than not treating at all. It will foster the development of TB antibiotic resistance in the community. It is also a waste of money.



Use multiple drugs.



TB bacteria have a nasty habit of developing resistance to drugs. Once resistance develops it never reverts. This creates problems, not only for the patient, but also for those whom he infects, in the case of an adult with cavitory lung disease. The picture shows TB meds for 2 weeks, laid out in an egg carton plus a matchbox and plastic bag. This is a convenient way of keeping each day's medication straight.

Sometimes drugs are mixed in each tablet.



Sometimes there are mixtures of drugs in each tablet. This bottle contains rifampin and isoniazid in a fixed proportion. This makes for convenience in taking medication; rather than taking 4 kinds of tablets, the patient only needs to take 2 kinds. There are drawbacks, however. If the patient is allergic to the medication, you cannot tell which component is the culprit. If you buy combinations you cannot deal with drug allergies.

Four drugs are ideal; three are o.k.



The current recommendation is to begin with four drugs and then revert to three drugs after 2 months. Under some circumstances this is not practical so you have to begin and also continue with three drugs.

Distinguish initial and maintenance treatment phases.

- ▶ First 2 months are the initial phase
- ▶ Subsequent 4, 6, or 8 months are the maintenance phase.

The usual routine is to give closely supervised, intensive treatment for 2 months, and then let the patient be responsible for his own medications thereafter, being seen only monthly during that time.

## DOTS works in urban areas.



DOTS stands for directly observed therapy short-course. It is a policy created and promoted by the World Health Organization. The idea is for a health practitioner to watch the patient swallow his medication every day for two months before sending him off on his own. This works well in urban areas where there are many treatment centers scattered all around the area. It's a disaster in rural areas. By definition, rural areas are less densely populated than urban areas. One cannot expect an ill subsistence farmer to spend 4 hours every day walking to and from a treatment center.

In my area, people who present to the health service with TB are incarcerated for their first 2 months of drugs. They are not fed; the only food they get is what their families bring them. It costs a day's wages for round-trip bus fare from the rural areas to the treatment center. TB drugs don't work with a low-protein diet. The family, if they bring their ill relative food at all, will bring him low protein foods, since this is all that is available. The death rate in this situation is very high.

Know where your patients live.



If you know where your patients live, you can go after them if they don't show up for a while. Knowing someone who knows is second-best but you might have to settle for that.

## Check urine for compliance.



When you give medication tell the person NOT to take it that day but to start the next morning. He is to always take it in the morning, not any other time of day. That being done, there are two ways of checking on him. One is to buy quantities of vitamin C (which is cheap) and give this along with the regular medication. It is harmless. Buy dipsticks that have an "ascorbic acid" element on them. In the States, dipsticks from Henry Schein Medical have that element. The patient's urine will be positive for ascorbic acid if he took his medication that morning. Another option is that, if you give rifampin, the urine will be a bright orange. You can see this visually. If it's not orange, he hasn't taken his rifampin that morning. Kick him out of the program after one warning.

## Before and after pictures help.



The picture on the left shows a girl who came to clinic in mid-June 2011 with the chief complaint of a distended abdomen and failure to thrive. She had a large amount of free fluid in her abdomen, along with a multitude of tiny nodules. She refused to eat. We started her on TB medication. The first 2 weeks her weight, which was already low, fell even more. We were worried, but the father said he thought she was improving. It turned out that she was. Her initial drop in weight was because of the fluid in her abdomen decreasing as a result of our high-protein granola. On the right is the same girl in mid-January 2012. It took a long time, but she responded spectacularly well to TB medication.



Affirm responsible behavior.



Maintaining a cordial relationship with your patients is essential. Greet them cheerfully and let them know that you care.

Create consequences for defaulting.

- ▶ Forfeit deposit money
- ▶ Name on list for future non-treatment
- ▶ Enforced housing isolation

While you want to be smiley toward your patients, you also want to let them know that you will not tolerate irresponsibility or fraud. They need to come faithfully to fetch their medications, and they need to give evidence of having taken them.

Now it's your turn.

- ▶ “His urine is light yellow, not orange, but he swears he took his TB meds this morning. What shall I do?”

(Pause, but do not read the slide aloud.) Discuss this with your group and give a verdict.

Kick him out of the program. He is selling the medication on the black market or else wasting it. If his TB is cavitary and thus contagious, appeal to the local authorities for enforced isolation.

## Your turn again.

- › Nun, chief cook at an affluent convent.
- › National physician, busy practice in a remote area, ready to retire.
- › Grandmother, living with the next generation, middle-class, poor health.
- › Homosexual male, HIV positive, but not yet very ill.
- › Grandmother, sole support of 5 grandchildren.

These people are all over 60 years old. They all have contagious, cavitary TB. If you can only treat two, who will it be? Discuss this with your group and give your decision.

There is no one right answer, but I would vote for the last one for sure. Some students would factor in the spiritual status of the individuals. Others would not. Most would not treat the homosexual male.

## And then the next question.

- › Nun, chief cook at an affluent convent.
- › National physician, busy practice in a remote area, wants to retire.
- › Grandmother, living with the next generation, middle-class, poor health.
- › Homosexual male, HIV positive, but not yet very ill.
- › Grandmother, sole support of 5 grandchildren.

These are the same people as in the last slide, all over 60 years old. If you have plenty of drugs so that you decide to treat them all, what other advice will you give, to help prevent the spread of the disease? Discuss this with your group, and offer a suggestion.

Another one.

- ▶ “I only have one TB drug. Should I use that by itself or wait until my other drugs arrive in 3 months?”

(Pause but do not read the slide script.) Discuss this with your group, and decide what to do.

Wait until the other drugs arrive. You will be fostering drug resistance by using just one drug for TB.

And now a last one.

- ▶ “Our church is taking a 2-week missions trip to Timbuktu. We want to start a TB treatment program while we’re there.”

(Pause but do not read the slide.) Discuss this with your group and then say what you think.

This is totally insane. You need to have a long-term commitment, a good command of the culture and language, and an infrastructure in place before you even start to think about a TB treatment program.

What's the bottom line?

**Run a tight  
ship!**



# The End

Suggestions, comments, and questions  
are welcomed.

[vanderkooim@gmail.com](mailto:vanderkooim@gmail.com)