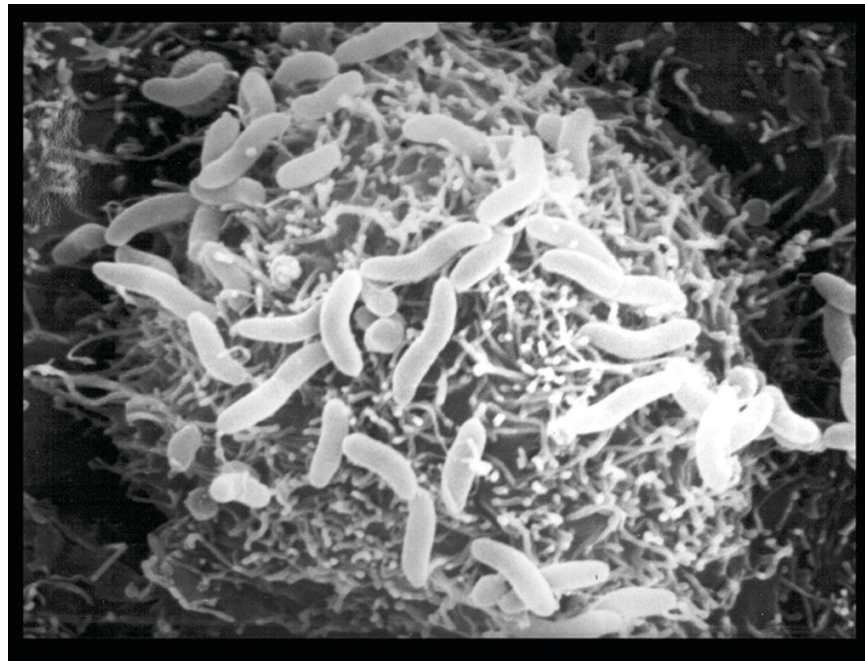


# MEDMYST MAGAZINE

A Companion to Web Adventures at <http://medmyst.rice.edu>

1.1

CHOLERA



Scanning Electron Micrograph of *V. cholerae* Courtesy of Dr. Richard A. Finkelstein

## A WIGGLING MENACE

Under a microscope, the bacterium that causes cholera appears to be rod-shaped, and scientists call any bacterium with this shape a bacillus (buh-SIL-us). The cholera bacterium bends slightly, similar to a comma. It moves with the help of a whip-like tail called a flagellum (flah-JEL-um).



Light Micrograph of *V. cholerae*  
Used with permission  
<http://www.bact.wisc.edu/Bact330/lecturecholera>

The bacterium also seems to vibrate when it moves, so scientists used the Latin word for vibrate (*vibrio*) and named the bacterium *Vibrio cholerae*, or *V. cholerae* for short.

## CHOLERA

### Acknowledgements

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**GREETINGS!** I'm Eureka, an intelligent bot specializing in scientific and historical data. The RECONSTRUCTORS rely upon my data files to help them solve **MEDICAL MYSTERIES**.

## CHOLERA

*Anyone in your neighborhood had cholera lately?  
Not on your list of most dreaded infectious diseases?  
What makes it so important?*

The history of cholera and its continuing presence in the world makes it an infectious disease worth knowing about. Cholera outbreaks usually occur where there are poor sanitation conditions. In the United States there have been incidents of cholera caused by eating shellfish contaminated with the bacterium. Treated water and proper toilet facilities are defenses against cholera. But did you know that around the world a billion people lack access to safe water and close to two billion people do not have adequate sanitary facilities? Cholera bacteria can spread in these conditions. As travel from one side of the globe to the other becomes more common, you may find yourself in a situation where cholera bacteria are present. Know the symptoms and the prevention measures!



*Courtesy of Dr. Robert Tauxe, CDC*

### How Do Medical Workers Diagnose Cholera?

Medical workers are trained to be on the lookout for cholera symptoms, particularly in people who live or visit places where cholera is endemic (en-DEM-ik), that is where the disease is known to be present. A very bad case of watery diarrhea is a warning signal.

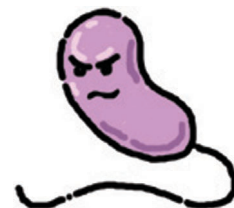
The usual symptoms of cholera are:

- Severe watery diarrhea
- Vomiting
- Leg cramps

In extreme cases a person can lose up to 10% of their body weight.

Fever and abdominal cramps are not usually associated with cholera.

A next step in confirming cholera is examining the person's feces (poop) under the microscope to detect the comma-shaped wiggling bacteria. Further clinical tests can also be performed to make certain of the diagnosis. But in the meantime, it is important to begin treatment immediately.





# Cholera

**BAD NEWS:** Easy to get if sanitation is not great

**GOOD NEWS:** Easy to treat

*Bad News*

Cholera is a disease of the intestines. It is most likely to occur in many of the developing countries in South America, Africa and Asia, where sanitary conditions are not sophisticated.



*DID YOU KNOW:* People infected with cholera can produce as much as one liter of "rice water" stool every hour. This is watery diarrhea that looks like it has specks of rice in it. Flakes of mucus and cells that line the gut give it the look of rice water.

When *V. cholerae* enters the body, it makes itself at home in the small intestine and begins secreting a toxin (poison). This causes the body to release an abnormally large amount of water into the intestine.

1 liter of liquid

**SHOCK!**

Cholera can cause death quite rapidly because the body loses important substances along with the water from the intestine. These substances, called electrolytes (E-lek-tro-lites), are actually minerals that are important for normal body function. The loss of fluid and electrolytes can cause a medical condition known as **SHOCK**. The blood pressure drops, the kidneys shut down, and the heart begins to beat irregularly. Shock is very dangerous and can lead to death.

*Good News*

To treat the body's fluid loss caused by cholera, it is important to replace the lost water and electrolytes. One remedy, which frequently is used and taken by mouth, is Oral Rehydration Solution (ORS). ORS is one of the greatest life-saving treatments. Millions of lives have been, and continue to be, saved by this therapy.



Not just any liquid will replace body fluids lost during diarrhea. Water alone does not have the needed electrolytes and salty drinks or foods can make the problem worse.



ORS is a very simple substance made by dissolving sugars and salts in clean water. It costs only pennies per patient. There are also recent rice-based rehydration solutions that have been developed that are equally effective.

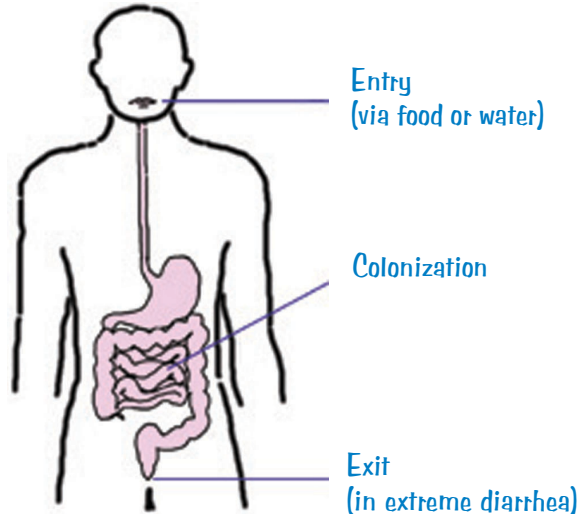
Most of the time, a patient's body will eventually destroy the cholera organism on its own. The objective is to keep the patient from losing too much water and electrolytes and allow the body to fight the bacteria.

*DID YOU KNOW:* An adult's intestine is about 24 feet long? Lots of room for cholera bacteria to set up their colonies!

# Cholera



Look at the picture on the right and see what happens when *V. cholerae* enters your body.



## How Does Cholera Spread?

*Cholera is NOT spread in the air.  
Cholera is spread through contaminated water or food  
in areas with poor sanitation.*

When feces containing *V. cholerae* have not been disposed of properly, the *V. cholerae* can enter the ground and contaminate the water supply. This produces "tainted" water. When people drink the tainted water or eat food prepared with it, *V. cholerae* bacteria can enter their intestines and can make them ill with cholera.



Good personal hygiene, such as thoroughly washing hands after using the restroom and before eating, will also help limit cholera from spreading. In other words, if persons who have *V. cholerae* in their poop wipe themselves, but don't wash their hands well, they can spread bacteria from their "poop-wiping hand" to food or other objects.

Cholera is a disease that tends to occur in epidemics (ep-eh-DEM-iks). This means that it suddenly appears in a given area and rapidly spreads through a group of people. In most cases, a cholera epidemic kills approximately three people for every one hundred people who contract the infectious disease. A great deal, however, depends on the strain of the bacteria and the speed with which people are treated. Some cholera epidemics have been much more deadly. Seven large waves (pandemics) of cholera have spread through the world since 1800. The current pandemic has raged since 1961 and shows no signs of letting up.

# EPI- DEMIC

### *DID YOU KNOW:*

*The US President James Knox Polk (1795-1849) died of cholera at the age of 53, a few months after his presidency ended during the third pandemic.*

# Cholera

## If *V. Cholerae* Could Talk (Or Rap)

If you look at the disease from the viewpoint of the bacterium, *V. cholerae*, this might be its story:

VC VIBE

Over the teeth and past the gums,  
Watch out stomach here we come.

Wiggling past your stomach acid  
Our plan is precise; our numbers massive.

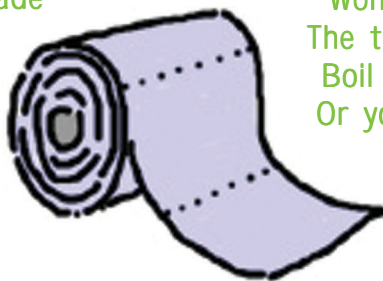
We're on our way to invade  
your gut

Secrete our toxin and  
then we'll strut.



For in the bathroom  
you'll have to stay,  
For minutes, then hours  
and even days.

Wondering what had made you ill  
The tainted water from over the hill?  
Boil the water and wash your hands  
Or you could be living in cholera lands.



## WONDER WHY?

Ever wonder why during an outbreak of cholera, not everyone living in the area will get sick? Some people will get very mild cases—so mild that they do not realize that they have the disease—while others will rapidly progress through cholera's stages and die. Why is this?



## Several Factors Affect a Person's Susceptibility to Cholera.

one

Age and health play a role in susceptibility. Even with the same exposure, the very old, the very young, or people who are already sick are more likely to get cholera than a healthy adult.

two

The amount of bacteria people come in contact with is an important factor, too. For example, a person who drinks a glass of heavily tainted water is more likely to get sick from cholera than one who drinks a glass with just a few bacteria in it.

three

Many characteristics of the bacterium determine both how many people become infected and how many become sick. Some strains of *V. cholerae* are more infectious (able to live in the body) than others. Also some strains are more virulent (better at overcoming the body's natural defenses) than others.

four

Even stomach acid is an important defense against the cholera bacterium. Older people naturally tend to have less stomach acid, and that increases their susceptibility. Also, persons who take acid blockers like Pepcid™ and Zantac™ to reduce their stomach acid can be at risk.

*DID YOU KNOW: As far back as 350 B.C., Hippocrates (known as the Father of Medicine) recommended boiling drinking water to get rid of impurities. Although microscopes had yet to be invented and no one could see germs in the water, it turns out his advice was right on target. Boiling water kills the *V. cholerae* bacteria.*



# Cholera

## How Can People Prevent Cholera?



Photos this page courtesy of Dr. Robert Tauxe, CDC

Of course the best plan is to avoid catching cholera in the first place. The key to prevention is **good hygiene and safe water**. This is easier said than done, particularly in countries torn apart by conflicts or natural disasters like earthquakes or floods. And in some countries when a large part of the population moves from the country to the city, there is often a problem supplying enough clean water or sanitary plumbing.

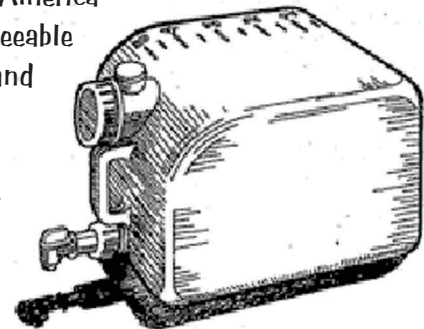


In the future, a cholera vaccine may be an effective strategy for prevention, but the current cholera vaccine is not in wide use now, for a variety of reasons.

## The SAFE WATER SYSTEM can help!



While the best long-term goal is to construct deep wells or piped water systems, a shortage of time and resources will leave hundreds of millions of people in Asia, Africa and South America without access to safe water into the foreseeable future. The Centers for Disease Control and Prevention (CDC) and the Pan American Health Organization developed the Safe Water System. This is a simple, inexpensive, and adaptable way to solve the clean water problem for the developing world.



This simple, but effective idea can help prevent cholera world wide. All you need are:

- (1) a narrow-mouthed plastic 20-liter jug with a lid;
- (2) a bottle of calcium hypochlorite solution (a form of chlorine, the ingredient in bleach you can buy at the grocery store); and
- (3) community education

To learn more about the Safe Water Project, visit their web site at <http://www.cdc.nih/safewater>.

*Why do you suppose it needs to be a narrow-mouthed container?*



# Cholera

## DISEASE DETECTIVES



History is filled with hard-working scientists who have made major discoveries about diseases. Their stories are much like detective novels. Could it be that they thought of themselves as being **MEDICAL DETECTIVES?**

In the case of cholera, a doctor named John Snow uncovered an important piece to the puzzle.

## STATISTICS, MAPS and DISEASE The Story of John Snow and the Water Pump

At the time of this story, it was not common for homes to have running water or indoor plumbing. People went to a common water pump to get their drinking water. Scattered around the city of London were water pumps supplied by different water sources.

On the evening of August 31, 1854, a terrible disease sprung up in a section of London near Broad Street. During that evening, 56 people were stricken with cholera. By the end of the next day, doctors diagnosed 143

more cases. This severe cholera outbreak provided one local physician, Dr. John Snow, with a chance to prove his hypothesis about the spread of cholera, but the stakes were high. Within just three days 127 people in the Broad Street Area were dead.

From his past research, Dr. Snow believed that cholera was spread through water by some

unknown organism. Other people tended to believe that cholera was caused by *miasmas* (invisible gasses rising out of the ground). Another local belief was that cholera was



Courtesy of the National Library of Medicine

spread from person to person by people breathing on one another. Snow reasoned that these could not be the real causes of cholera. If it was caused by a gas, he would be breathing the same gas as his sick patients as he made his rounds of their homes and neighborhoods. If it was transmitted through the air, it should have been transmitted to him when his patients breathed on him. Yet Dr. Snow did not get cholera.

He also pointed out that the first symptoms of cholera occurred in the digestive system. This suggested that something people ate or drank caused the disease.

Three days after the cholera epidemic began, Dr. Snow initiated his investigation. Still believing that cholera was spread through water, Snow went in search of evidence to support his hypothesis. The doctor obtained a list of the recent cholera deaths and plotted them on a map of the Broad Street area. He discovered that 79 out of the first 89 deaths occurred in people who





# Cholera

lived nearest the Broad Street pump. Also providing some supporting evidence was the fact that the men who worked at the local brewery and who did not drink the water, but only beer, did not become infected. Furthermore, the doctor discovered that only 5 of 530 local prison inmates had contracted the infectious disease. He noticed that the prison owned its own well.

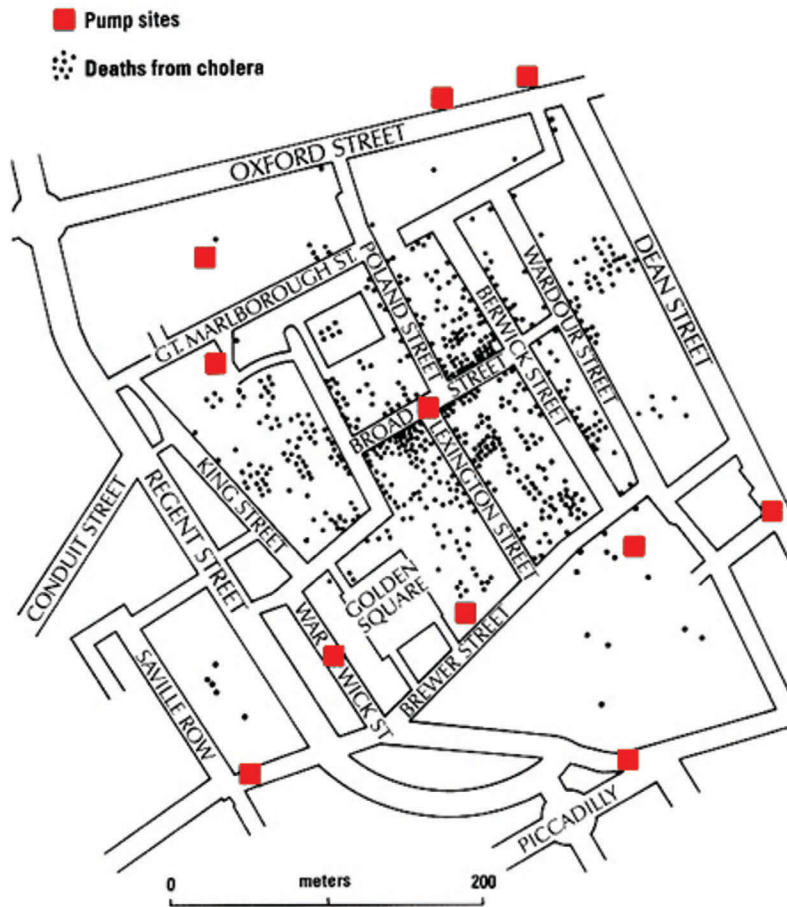
Dr. Snow then interviewed the families of the cholera victims. Time and again, the families confirmed Snow's hypothesis—the cholera victims had consumed water from the Broad Street well.

When Dr. Snow presented his findings to local officials, they removed the pump handle from the Broad Street well, and the spread of cholera suddenly stopped.

Despite his evidence, some community members, including Reverend Henry Whitehead, challenged Dr. Snow's findings. Reverend Whitehead argued that the cholera outbreak was divine intervention, or the work of God, and conducted his own investigation. Rather than disproving Snow's hypothesis, the Reverend Whitehead admitted that his own research strengthened Snow's idea. Whitehead learned that a family with a sick child,

infected with cholera, had washed diapers and dumped the diaper water into a pool near the well.

Dr. Snow shared his solution to this MEDICAL MYSTERY. His book, *On the Mode of Communication of Cholera* was published in 1855. It has since become one of the most important works for the study of epidemics and it is a classic in the field of epidemiology. Now many public health workers use the same techniques that Dr. Snow used to track down the source of disease.



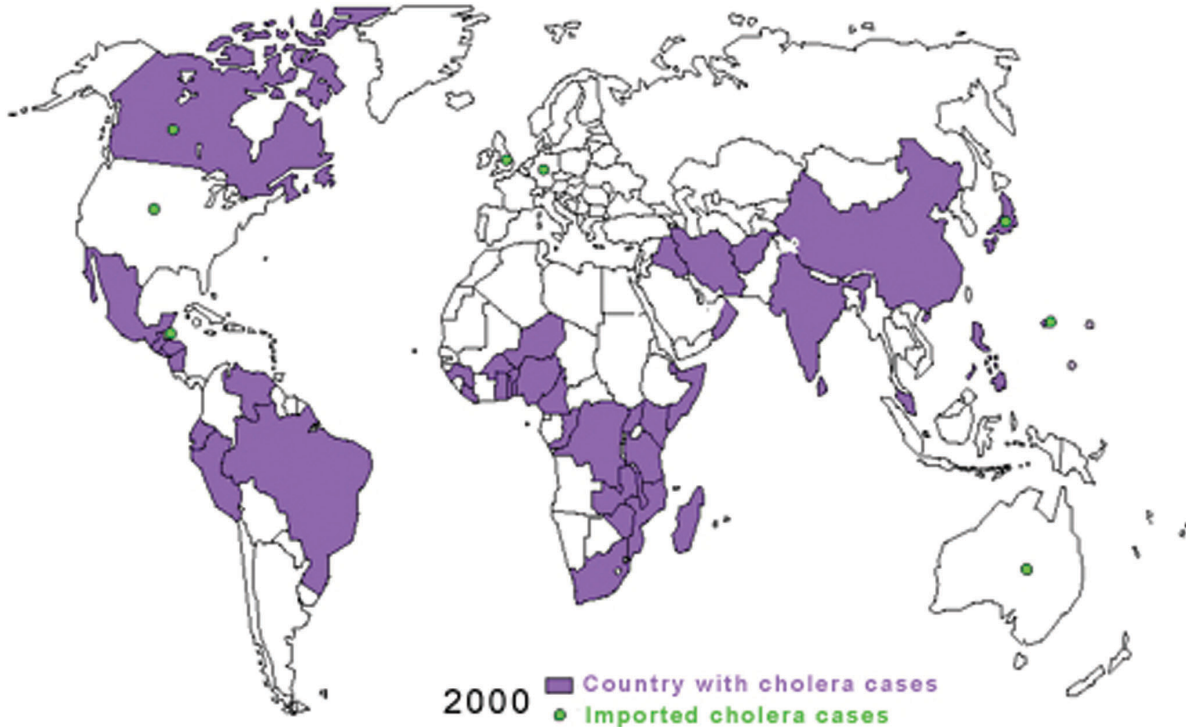
*Dr. Ralph R. Frerichs at the University of California Los Angeles maintains an excellent web site on John Snow. Check it out:*

<http://www.ph.ucla.edu/epi/snow.html>

# Cholera

## MAPPING CHOLERA

Map adapted from the World Health Organization  
Weekly Epidemiological Record No. 31 <http://www.who.int/wer>



### Where Do We Find Cholera Today?

The map above provides a snapshot of the world's reported cholera cases in the year 2000. Some cholera outbreaks happened locally, and some reported cases were actually brought in by travelers. Parts of Africa are fighting a cholera epidemic that has been raging for thirty years. A cholera epidemic that first appeared in Peru in 1991 still is a major concern in South America. In areas like these, breakdowns of sanitation or large-scale movements of people fleeing disaster (like a flood or earthquake) can overload local efforts to combat the disease.

### Medical Geography Quiz

Can you **identify** at least 3 countries in **Africa** that had cholera cases in 2000?  
Can you **identify** at least 3 countries in **Latin America** with cholera cases in 2000?

### Advice from the Centers for Disease Control and Prevention Six Recommendations for All Travelers to Areas Where Cholera Has Occurred

1. Drink only water that you have boiled or treated with chlorine and iodine. Other safe beverages include tea and coffee made with boiled water and carbonated, bottled beverages with no ice.
2. Eat only foods that have been thoroughly cooked and are still hot, or fruit that you have peeled yourself.
3. Avoid undercooked or raw fish or shellfish.
4. Make sure all vegetables are cooked; avoid salads.
5. Avoid foods and beverages from street vendors.
6. Do not bring perishable seafood back to the United States.

*A simple rule of thumb is: "Boil it, cook it, peel it, or forget it!"*

# Cholera

## What If You're Going to Travel Abroad?

The following organizations are concerned and involved with the health of travelers. Their websites contain reliable information about cholera and other infectious diseases, and the risks of diseases around the world.

**web  
sites**

The United States Centers for Disease Control and Prevention  
<http://www.cdc.gov>

The World Health Organization  
<http://www.who.int>



*DID YOU KNOW: In the public latrines of ancient Rome, a communal bucket of salt water stood close by. In it rested a long stick with a sponge tied to one end. The user would cleanse his person with the spongy end and return the stick to the water for the next one to use. The stick later evolved into the shape of a hockey stick, and is the source of the expression "getting hold of the wrong end of the stick."*

*From <http://www.theplumber.com/plague.html>*

## AN UNCONFIRMED REPORT

### *A Word Surprise Activity*

This activity is fun to play alone or with the entire class. Using the numbered list below, fill in the blanks with the type of word that is requested. Then, using the words that have been chosen, fill in the corresponding blanks in the story on the back page.



*DO NOT look at the back page until you have completed the list.*

1. Plural noun \_\_\_\_\_
2. Verb \_\_\_\_\_
3. Noun \_\_\_\_\_
4. Color \_\_\_\_\_
5. Noun \_\_\_\_\_
6. Number \_\_\_\_\_
7. Number \_\_\_\_\_
8. Verb \_\_\_\_\_
9. Number \_\_\_\_\_
10. A liquid \_\_\_\_\_
11. Verb \_\_\_\_\_
12. Adverb \_\_\_\_\_
13. Exclamation \_\_\_\_\_
14. Noun \_\_\_\_\_
15. Adjective \_\_\_\_\_



# Cholera

## AN UNCONFIRMED REPORT



*Cholera is an infectious disease that is common in areas with poor sanitation. In*

*these places, the water is so dirty that \_\_\_\_\_ are commonly found to*  
(1) PLURAL NOUN  
*\_\_\_\_\_ in the water. If you get a severe case of cholera, you'll be so sick*  
(2) VERB  
*you'll feel like a \_\_\_\_\_ and look like a \_\_\_\_\_*  
(3) NOUN (4) COLOR (5) NOUN  
*Your body may ache and you may excrete \_\_\_\_\_ gallons of watery rice*  
(6) NUMBER  
*stool, so you'll have to sit on the toilet for \_\_\_\_\_ hours or even days.*  
(7) NUMBER  
*Cholera is caused by the bacterium Vibrio cholerae. This bacteria invades your diges-*  
*tive tract and will \_\_\_\_\_ there until you flush it out. Vibrio cholerae*  
(8) VERB  
*secretes a toxin, which causes such severe diarrhea, that you'll need \_\_\_\_\_*  
(9) NUMBER  
*gallons of water mixed with salt and sugar to rehydrate your body and prevent shock.*  
*Some people like to drink \_\_\_\_\_ instead but this is not recommended. If you*  
(10) A LIQUID  
*think you have cholera, you should \_\_\_\_\_ \_\_\_\_\_ to your doctor*  
(11) VERB (12) ADVERB  
*who may say, " \_\_\_\_\_ " and quickly take a stool sample. This won't hurt but*  
(13) EXCLAMATION  
*it may make the room smell like a \_\_\_\_\_.*  
(14) NOUN  
*Cholera can cause death but if*  
*you follow your doctor's advice, drink only clean water and wash your hands and food*  
*thoroughly, you should feel \_\_\_\_\_ in no time at all.*  
(15) ADJECTIVE