

Bacteria and Antibiotic Resistance

In People with Cystic Fibrosis

Antibiotic resistance results from bacteria changing in ways that make those antibiotics no longer useful. Resistance is a common yet problematic issue in treating pulmonary exacerbations or infections in people with Cystic Fibrosis (CF). Not all bacteria are bad. However, there are some that can cause infections. As bacteria are exposed to antibiotics over time, resistance may develop, and the number of antibiotics we have to kill the bacteria decreases as well. Thus, it is important to learn what causes antibiotic resistance and ways to prevent it.

**Words in bold italics are defined in the Glossary section*

What are bacteria?

Bacteria are microorganisms that live in and around us. They may be helpful, but sometimes may cause infections like ***sinusitis, pneumonia, or pulmonary exacerbations***.



What is an antibiotic?

An antibiotic is a term for a drug or other substance used to kill or slow the growth of bacteria.

What is antibiotic or drug resistance?

Antibiotic or drug resistance is the result of bacteria changing in ways that reduce

or eliminate the effectiveness of drugs or other agents used to treat infections.

With antibiotic resistance, bacteria are now able to survive the use of these drugs meant to kill or weaken them. This is an example of *acquired resistance*. Bacteria may also have *intrinsic* or natural resistance.

What is intrinsic resistance and what are some examples of bacteria with this type of resistance?

Intrinsic resistance is when bacteria are resistant to antibiotics naturally, without having prior exposure to antibiotics.

This can be a problem in terms of treatment, since the number of antibiotics for these bacteria may be limited.

An example of bacteria with intrinsic resistance is *Burkholderia cepacia* (bur-COLD-air-ee-ah sa-PAY-sha).

What are some examples of bacteria that can acquire resistance?

The most common bacteria that can acquire or develop resistance is *Pseudomonas aeruginosa* (soo-da-MOE-nus A-ridge-a-NO-sa). *Pseudomonas* can develop resistance to several antibiotics. Another bacteria is *Staphylococcus aureus* (STAFF-ee-loe-KOK-us OR-i-us). When resistance

develops, it is commonly called **MRSA for methacillin** (METH-a-SILL-in) resistant or **ORSA for oxacillin** (OX-a-SILL-in) resistant *Staphylococcus aureus*.

How does resistance develop?

The most common way resistance is acquired is by *exposure* to antibiotics.

For example, every time you take a course of antibiotics, you are “exposing” the bacteria to those antibiotics.

Each time bacteria are “exposed” to antibiotics, they can change in a way that the antibiotics are no longer effective.

Another way of acquiring resistant bacteria is through contact with other people or equipment when not using appropriate **standard and contact precautions**. This is why hand washing, hygiene, and washing of respiratory equipment is very important. Also, standing at least 3 feet away from other people with CF is important.

How fast does resistance develop?

With antibiotic exposure, resistance generally develops overtime. The length of time depends on the bacteria and the antibiotic, which can range from one treatment course to several.

Do resistant bacteria ever go away?

Unfortunately, if you have resistant bacteria, it generally does not go away, and is very difficult to eradicate or kill completely.

What are the antibiotics that bacteria can develop resistance to?

Bacteria can develop resistant to just about any antibiotic. Below are the most commonly used ones to treat an exacerbation or infection.



- **Beta-Lactams:**
 - *Penicillins*
e.g. piperacillin/tazobactam (Zosyn)
 - *Cephalosporins*
e.g. Ceftazidime (Fortaz)
e.g. Cefepime (Maxipime)
 - *Carbapenems*
e.g. Imipenem (Primaxin)
- **Aminoglycosides:**
e.g. Tobramycin and TOBI
e.g. Gentamicin and Amikacin
- **Quinolones:**
e.g. Levofloxacin (Levaquin)
e.g. Ciprofloxacin (Cipro)

What do the different terms mean, like resistance, or sensitive, etc?

Often times, a **sputum culture** is obtained during a hospitalization or clinic visit to see what bacteria you may have and what antibiotics can be effective in fighting it. The terms below are used in the “**Microbiology Report**” to indicate if a particular antibiotic will be effective.

Sensitive

Means that the bacteria are still “sensitive” to the effects of antibiotics and therefore can be killed or weakened by them.

Intermediate

Means that the bacteria is between sensitive and resistant to the effects of antibiotics and the antibiotics may no longer be effective in killing the bacteria

Resistant

Means that the bacteria are “resistant” to the effects of antibiotics. When bacteria are resistant, they are no longer killed or weakened by the antibiotics. The bacteria are considered resistant, when at least one major class of antibiotics is no longer effective in killing the bacteria.

Multi-Drug Resistant

Means that the bacteria are resistant to at least two major classes of antibiotics.

Pan-Resistant

Where the bacteria are resistant to all the major classes of antibiotics.

What is Isolation?

It is a method for **infection control** to prevent the spread of infection or resistant bacteria between patients. In addition to **standard precautions**, isolation is also called transmission-based precautions. Gowns, gloves, and masks are also a necessary part of isolation.

There are three types of isolation:

- (1) **Contact precaution** is to most commonly used to reduce the risk or transmission of bacteria

between patients. For example using gloves, and gowns when direct contact is expected.

- (2) Droplet precaution reduces the risk of transmission of large-particle droplets which requires close contact since droplets do not remain suspended in the air and generally travel only short distances, usually 3 ft or less, through the air. For example, masks would be used.
- (3) Airborne precaution reduces the risk of airborne transmission of infectious agents that may remain suspended in the air for long periods of time, like tuberculosis. Masks that filter out small particles are used.

If you are put in “isolation,” it is for your and other patient’s protection as well to prevent the spread of bacterial or antibiotic resistance.

How Can Antibiotic Resistance be prevented?

By using antibiotics appropriately

This means for you to take your antibiotics exactly as prescribed or instructed, even if you feel you no longer need to take the antibiotic.

By preventing the spread of resistance

This means that you should:

- Cover your mouth and nose when coughing or sneezing.
- Wash and dry your hands or use an alcohol-based hand gel.



- Limit contact with other people with CF or stay at least three feet from others with CF
-

Glossary

Acquired Resistance – refers to when bacteria change in ways that reduce or eliminate the effectiveness of antibiotics used to treat infections

Infection Control – refers to policies and procedures used to minimize the risk of spreading infections, especially in hospitals and health care facilities

Microbiology Report – reports results of antibiotics tested on bacteria; tells whether a bacteria is sensitive, intermediate, or resistant to antibiotics tested

MRSA – stands for methicillin-resistant *Staphylococcus aureus*.

ORSA – stands for oxacillin-resistant *Staphylococcus aureus*.

Pneumonia – inflammation or infection of the lungs

Pulmonary exacerbation – worsening of pulmonary symptoms such as increased cough, sputum production, chest congestion, shortness of breath on exertion or exercise

Sinusitis – inflammation of the sinuses. Sinuses are the hollow areas in the skull around your nose.

Sputum culture – Sputum is material coughed up from the lungs and spit out through the mouth. A culture of the sputum is done to find and identify the microorganism causing an infection by placing it in a medium under conditions that allow it to grow. If a microorganism is found, testing is done to determine which antibiotics can weaken or kill the bacteria and thus will be used to treat the infection.

Standard precautions – designed to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources of infection and applies to all patients receiving care in a hospital. For examples wearing gloves when handling blood, body fluids, secretions, or mucous membranes, or wearing a gown.

Resources

- For more information on preventing antibiotic resistance, see the Cystic Fibrosis Foundation Website Brochure on “Stopping the Spread of Germs.” http://www.cff.org/living_with_cf/patient_and_family_education.cfm
- For more information about antibiotic resistance, see the Center for Diseases Control Website <http://www.cdc.gov/drugresistance/general>
- For more information about isolation, standard and contact precautions, see the Center for Diseases Control Website <http://www.cdc.gov/ncidod/hip/ISOLAT/Isolat.htm>



Contributing Authors

Jane Kriengkauykiat, Pharm.D.
Anti-Infective Research Fellow
University of Southern California
Los Angeles, CA

Debbie Benitez, R.N., M.S.N., A.C.N.P.
Pulmonary Nurse Practitioner
University of Southern California
Los Angeles, CA

Paul Beringer, Pharm.D.
CF Associate Director of Research
University of Southern California
Los Angeles, CA