



**County of Moore
Health Department
705 Pinehurst Avenue • P.O. Box 279
Carthage, NC 28327**



**Robert R. Wittmann, MPH
Director**

**Telephone: 910-947-3300
Medical Records Fax: 910-947-1663
Administration Fax: 910-947-5837**

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Contact: Paul Kuzma, MD
910-315-1367
kuzmpj@gmail.com

Introduction

In order to help communicate with the citizens of Moore County, county Health Director Robert Wittmann, MPH has partnered with Paul Kuzma, MD to prepare a series of articles meant to inform the public about Covid-19 and public health. Dr. Kuzma has practiced medicine in Moore County for over 20 years and is currently completing his Masters of Public Health degree at Johns Hopkins University. This is the second in a series of articles prepared by Dr. Paul Kuzma to further public understanding of Covid-19.

The Basics of the Immune System

How does our body fight off infections?

What is convalescent plasma?

What are monoclonal antibody treatments?

How do vaccines work?

All of these important questions require a basic understanding of our bodies' immune system. The immune system is incredibly complex, and some doctors spend their entire careers treating immune system disorders. However, everyone can benefit from a basic understanding of how it functions. This article will help inform future articles about Covid-19 including treatments, vaccines, the potential for herd immunity and control of this disease.

Our immune system allows us to survive in a hostile world. There are any number of bacteria, viruses, toxins, and tumors that want to invade our bodies and use them for their own purpose. They try to take over our cells and use them to reproduce themselves at our expense. Without a strong and adaptable immune system, we wouldn't last long!

We never know what invader is going to attack us next, so our immune system must be able to recognize all sorts of outsiders and defend against them. If we can respond quickly and effectively, we can overcome the disease. If we are unable to adapt and fight it off, it can get a foothold in our bodies and cause chronic disease or death. How does our immune system defend us?

"To Protect and Promote Health through Prevention and Control of Disease and Injury."
<http://www.moorecountync.gov/health/>

**Environmental Health
Telephone: 910-947-6283
Fax: 910-947-5127**

**WIC
Telephone: 910-947-3271
Fax: 910-947-2460**

B-cells, T-cells, antigens, and antibodies.

B-cells are a crucial component of our immune system. They are able to recognize things that don't belong in our body and mount a defense against them. All cells, including viruses and bacteria, are unique and have molecules on their outside that are specific to that particular type of invader. These unique and specific molecules are called antigens. When a B-cell comes in contact with an invader, it is able to recognize that it doesn't belong in the body because the B-cell doesn't recognize the antigen on the outside of the invading organism. The B-cell then produces receptors on its surface that recognize and attach to the antigens on the invader, thus neutralizing it. It also begins to produce molecules that it can release into the bloodstream that can recognize and attach to the antigens on the invaders. These molecules are called antibodies and they circulate in our blood looking for invaders to neutralize.

Antibodies are incredibly specific for the antigen on the particular invader that they were created to combat. Think of them as hunters that are only able to attack a very specific type of pest. Antibodies can circulate in our bloodstream for months to years and provide ongoing protection against a repeat attack or reinfection with the invading organism. There may be some protection from infection if the person has been previously infected with a very similar organism that had very similar antigens. Some people who have recently had the common cold, which is also caused by a coronavirus, may have partial immunity to Covid-19 through this mechanism.

As you can imagine, it takes time for our bodies to mount an effective antibody response, and during this time, the invader can continue to reproduce, damage cells, cause disease and even death. In some cases our bodies can't produce effective antibodies, so some invaders may not be stopped by this defense.

Another type of cell that is involved in our immune protection are T-cells. There are different types of T-cells including killer T-cells, helper T-cell and memory cells.

Killer T-cells are able to recognize cells that are infected with a particular organism and destroy those cells. This cell-based immunity can help prevent the invaders from causing extensive disease by destroying infected cells and preventing further reproduction of the invader within the infected cell. Helper T-cells stimulate B-cells to make more antibodies. Memory cells remain in the circulation and can recognize a reinfection with an invader and stimulate a more rapid B-cell immune response.

In some cases, the immune system can respond in a way that can damage the person with the disease as well as the invading organism. When this happens, the person may suffer damage or even death as a result of an overly strong or uncontrolled immune reaction. Why some people generate this type of response is not well understood, but many people with severe Covid-19 disease seem to have features of an overactive immune reaction.

As you can see, the immune system is incredibly complex but an understanding of the basic function of the immune system will allow us to further explore some of the treatments for Covid-19 such as convalescent plasma and monoclonal antibody therapy. This understanding will also allow a better understanding of how vaccines work and what is meant by herd immunity. It also helps to explain why some people have such severe disease and why powerful anti-inflammatory steroids can help them to survive.

We will discuss all of these in greater detail in future articles.