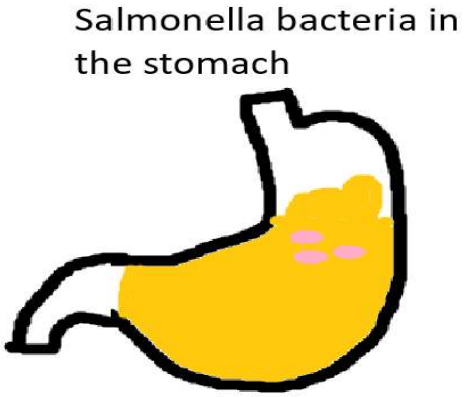
BI103 Spring 2024

Defenses Lab

Let's consider salmonella, a real life bacteria which causes many gastrointestinal complications. They look like fuzzy rods and are typically transmitted to humans by way of eating raw/undercooked food, mostly poultry or if feces found its way onto the food. The bacteria nests itself in the intestine of an individual and can produce symptoms of diarrhea or vomiting. If left untreated, it can lead to urinary tract infections which puts the individual in greater pain and discomfort.

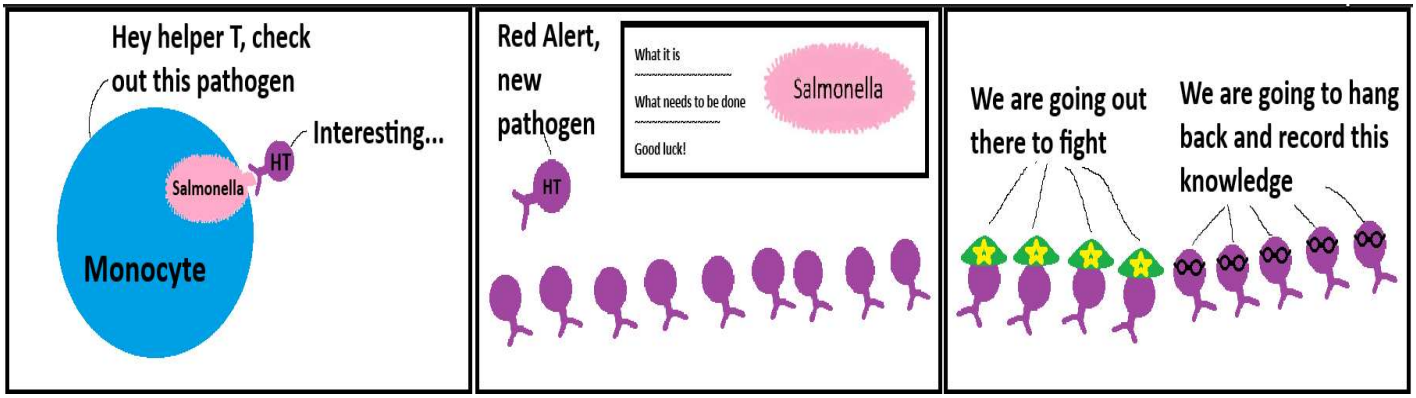


In order for salmonella to get through the body's barriers, it has to enter the body in the first place via consumption. This is a fast tract through the body and into the interior, yet there are still some obstacles the salmonella bacteria must deal with. In the gastrointestinal tract there are mucous membranes which secrete mucus. Mucus traps pathogens while cilia work to send them towards exits in the body. If this isn't enough, when it comes to the digestive system there is the stomach to deal with, and the stomach has a strong chemical barrier with its acid.

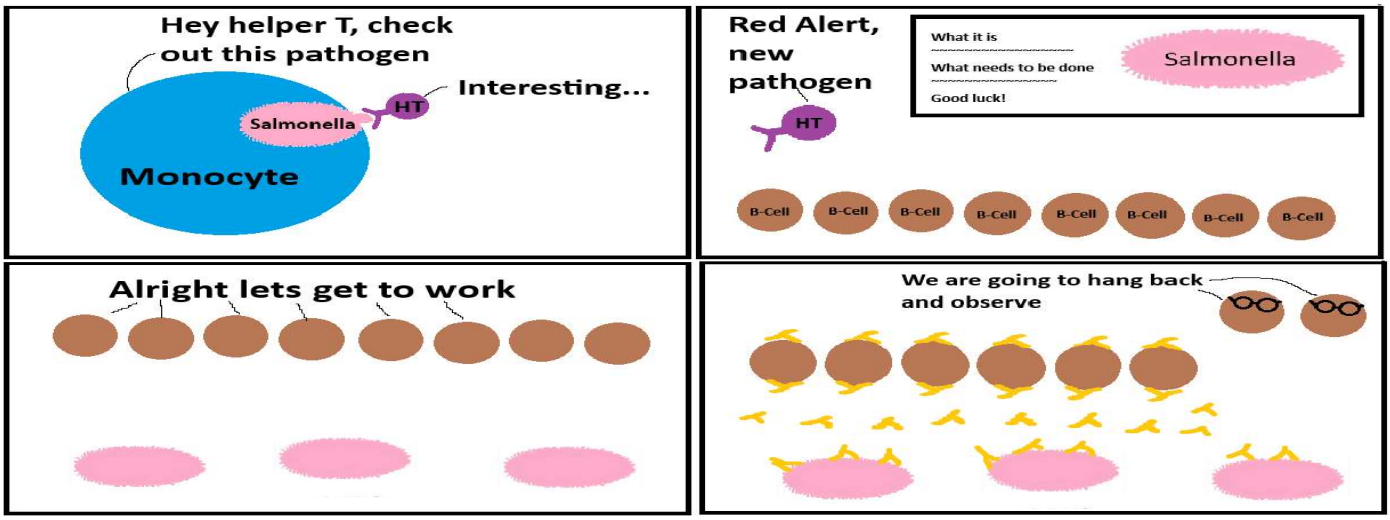
While there is no direct inflammation which occurs due to a salmonella infection, if left untreated it can damage tissue in the intestines and lead to inflammation. In this case, salmonella can interfere with epithelial cells and damage them, damaging the lining of the intestine in the process. When these epithelial cells are damaged they release chemical messages, distress calls if you will, prompting the body to respond. Blood comes in and begins administering aid to the damaged area, the first task being getting rid of the damaged cells. Natural killer lymphocytes are tasked with this job, destroying the damaged epithelial cells so new ones can take their place. It is then time for the cleanup crew to arrive, firstly neutrophils undergo differentiation and become phagocytes, eating the leftovers. They are then followed by monocytes that are now macrophages, eating what the phagocytes couldn't.

So how is salmonella or some other pathogen dealt with once it has fully infiltrated the body? Well the body has a last resort in immunity, either via cells or antibodies, to have a last stand. Cell-mediated immunity is when the body recognizes something foreign has gotten inside, and needs to be expelled. This is usually referred to as an antigen, where a pathogen triggers some response by the immune system. In order for this to happen, there is a process that has to occur. After the natural killer lymphocytes have taken care of business killing the damaged kills, the monocytes which have differentiated into macrophages come in to collect evidence, the antigen. The evidence is then exposed to helper T cells (T-cells are a type of WBC originating from the thymus) so that it can be identified and noted. Helper-T then goes and

informs other T-cells about it and what to do about it, and some go straight to action while some sit back and note. These are cytotoxic T-cells and memory T-cells respectively. This process is a bit simpler with this visual circling back to our salmonella example.



A similar scenario occurs in antibody-mediated immunity. Once again helper T-cells are informed of a pathogen, but instead of relaying that information to other T-cells they go to B-cells (WBC originating from bone marrow) and help create antibodies. An antibody is a blood protein which targets a specific antigen, which then latches onto its target and essentially ties it down, making it easier for the natural killer lymphocytes and cleanup crew to do their job. Once again some B-cells may opt into getting right to work while some might hang back. These are Plasma B-cells and memory B-cells respectively.



Assuming our pathogen, salmonella, was taken care of and is no longer in the body, the immune system has done its job. Now it needs to stop. This is where suppressor T-cells come in and halt all operations being conducted, stopping helper T-cells from assisting, stopping cytotoxic T-cells from killing, and stopping plasma B-cells from producing antibodies. This is done so the immune system does become overactive, which could lead to autoimmune disorders.