

OTTAWA SCIENCE INNOVATION CHALLENGE



Ottawa Science Innovation Challenge

2019/20





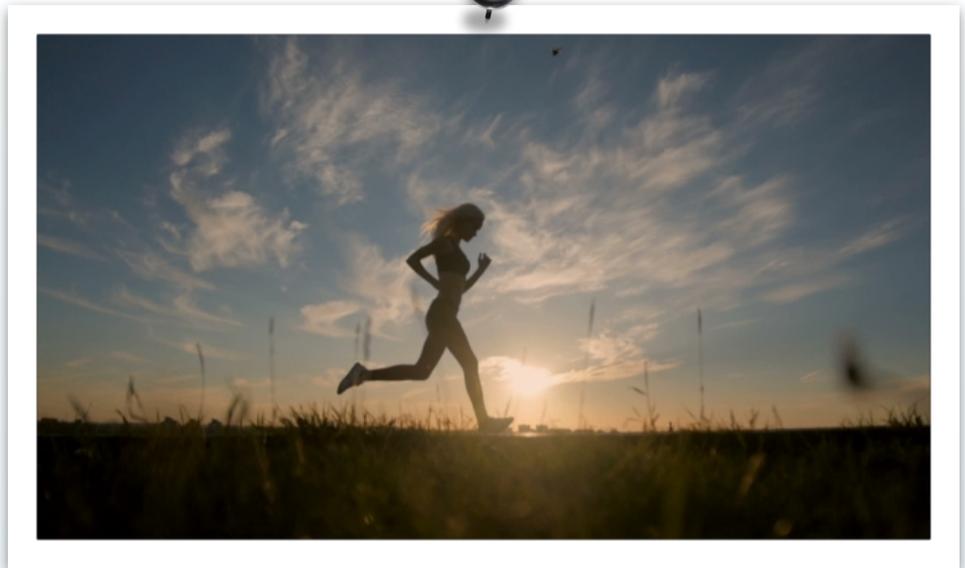
Acknowledgments

This case was developed by Kitty Chen, Elie Njeime and Shauna Han from the University of Ottawa.

Case designed by Elie Njeime

CASE 1 - EMBARRASSMENT

Penelope Cooper has always been the perfect student. She is known as a hardworking, problem-solving, motivated and driven young adult. She loves participating in physical activities and has even been a part of her high-school volleyball team for three years now.



Penelope was entering her senior year when she first started experiencing abnormal stomach pains and fatigue. She even occasionally experienced nausea after consuming certain meals. This pain was debilitating and began to severely affect her everyday life.

One day, Penelope decided to visit her family physician, Dr. Gardner, with the hopes that she could be given a solution to her problems.

"Hello, Penelope! It's nice to see you again, how are you feeling? Are you still on that volleyball team of yours?"

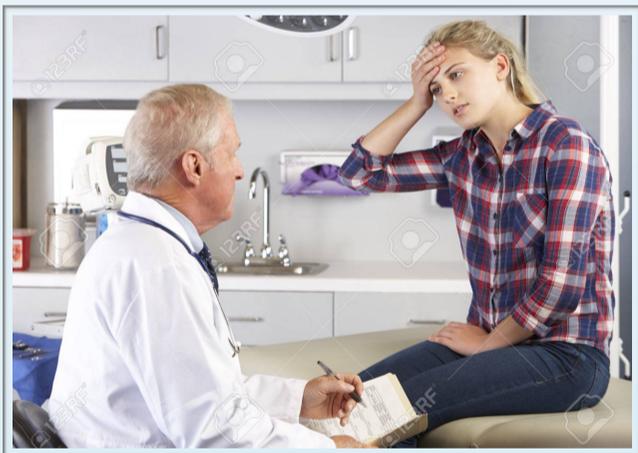
"Hello Dr. Gardner, I've actually recently taken a break from sports...my current health conditions have not been treating me so well lately".

Penelope seemed to be embarrassed, almost too shy to try and explain to Dr. Gardner what has been happening to her.

"What's the matter Penelope? You don't need to be scared of telling me what's going on, I'm only here to help you out," said Dr. Gardner with deep concern.

"Well...I've been experiencing extremely painful stomach aches lately. I've noticed that I'm becoming weaker by the day and I've been going to the bathroom more frequently than usual. This has been affecting my studying and my activities. As I mentioned to you, I stopped playing volleyball because of these symptoms. I am not sure what is causing this, I have not changed my diet in years and I have been physically active since I was a little girl!"

"Hmm...sounds like this is really affecting your day-to-day life. Not to worry Penelope, we'll figure out what's going on."



After several tests, Penelope was later diagnosed and treated for ulcerative colitis. However, Penelope noticed that her symptoms weren't getting any better and were even worsening with time.

"Mom! My stomach is really hurting again!" Said Penelope, curled up on the sofa in unbearable pain.

Her mother entered the room with dry crackers and a cup of hot peppermint tea, her favorite comfort foods when the pain reached extreme levels.

Penelope was still attending high school while experiencing all of these symptoms -- and she was perfect at hiding them.

What would they think if they knew about it? What if I don't make it to the bathroom fast enough? What if people laughed? What if someone heard me in the bathroom or went in after I was done? All these questions haunted her every second of the day as she sat in class.

Penelope was no longer dealing with the stress of completing senior year and maintaining her perfect track record, instead she started stressing about stuff that no teenager would usually have to stress about. She would leave class early because she needed to rest from being too weak, she started seeking out vacant bathrooms



because she was too embarrassed to use bathrooms that are located in high-traffic areas and she would always bring fragrances to mask the smell.

Time went on and Penelope noticed that she's not only being affected physically, but mentally as well.

Her anxiety levels reached its peak when she had her first panic attack in the middle of a final exam - an exam for which she was not prepared to write due to her illness.

She was too shy to explain to her teachers why she was unable to perform as well. Not even any of her friends knew what was going on with her mental and physical health.

Penelope couldn't handle it anymore. She had lost a considerable amount of weight and the diarrhea/vomiting was only getting worse. One day in class, Penelope had a very severe vomiting attack. She was rushed to the hospital where they conducted more tests over the course of several days.



Penelope had finally been **properly** diagnosed with Crohn's disease.

What a relief she thought to herself. She was finally being treated for the right illness. However, the physicians explained to her that the treatment would not be an easy one.

"Crohn's disease is an inflammatory bowel disease that causes inflammation in the lining of your gastrointestinal tract. This means that it affects the way your body processes the food you eat and explains the troubles you've been having with your stomach pains.

Penelope, Crohn's does not have a known cure at the moment. You will undergo many different treatments that require a variety of medications, diets, tests, X-rays, steroids and possibly surgery. From here on, your life will be considerably different. There are many activities that you will no longer be able to participate in and you will need to start giving yourself more time to rest. This will require a lot of sacrifices from your end."

After months and months of treatments, Penelope finally felt like she was energetic enough to slowly return to her old routine. She became more and more confident as time went by and even began discussing her illness with others. Throughout all of the challenges and hard times, Penelope went through (and still goes through), she has become a stronger person than she was before.

Penelope still suffers from Crohn's disease because there is still no cure for the illness. However, she has learned to deal with her symptoms and find ways around it. *What will the future bring? How will I face new environments like university or work? One thing is certain, though... I must never let it stop me from being who I am. All I could do at this point is embrace who I am and live every day to the fullest.*



CASE 2 - THE CONFERENCE



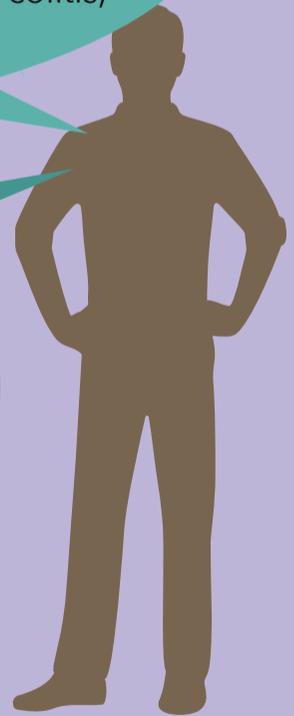
Mark Pimento is a postdoctoral fellow at the University of Arizona, and he has been preparing for a conference for months as a guest speaker. His research is focused on ulcerative colitis and microbiota manipulation. On the day of the conference, he checks in with a few minutes to spare and he makes his way to a seat before opening marks are made.

"I'd like to thank everyone for attending our second annual Crohn's and Colitis Congress! I would like to extend to you our warmest welcome, especially to those who have travelled far to attend this conference.

The central focus for today is on Ulcerative Colitis. For those who don't know, ulcerative colitis is a chronic inflammatory condition characterized by relapsing episodes of inflammation in the mucosal layer of the colon. The symptoms are characterized by bloody stools and abdominal pain. With the ongoing research and discoveries in inflammatory bowel disease (IBD), there is less data concerning the exact causes and therapeutic interventions of ulcerative colitis, also known as UC.

Today we have two notable speakers that will discuss the growing field of diagnostics and therapeutic interventions for UC. A general outline for today's conference is a discussion about current UC diagnostics by Dr. Gervais, followed by a discussion about UC therapeutic interventions by Mark Pimento. We will end the event with a chance to network with those working in the field of UC.

First let's give a warm welcome to Dr. Gervais from the University of Florida!"



"Thank you for the introduction! As some of you may know, we have been continually improving UC diagnostic techniques. Some of these techniques include analyzing medical and family history, physical exams, lab tests for microbiota irregularities, and endoscopies of the large intestines. Our lab is focused on looking for a specific gene that is consistent with patients diagnosed with UC. Through our research, we discovered that levels of perinuclear antineutrophil cytoplasmic antibodies (pANCA) and *Saccharomyces cerevisiae* antibodies (ASCA) seem to be associated with UC!"

As Dr. Gervais continues his talk, Mark is anxiously waiting for his time to present. He quickly does a mental sweep of his key points when suddenly..

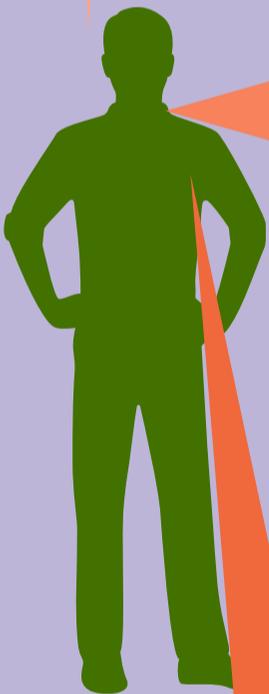
"Thank you Dr. Gervais for the remarkable accounts of diagnostic methods. To accompany this, we would like to bring out Mark Pimento to discuss about the ongoing UC therapies."

Mark walks up to the podium, thinking how quickly time flies. He adjusts the mic and prepares his talk.

"Thank you! Since we are all now familiar with diagnostics, we shall delve into the background of microbiota and its importance for determining therapeutic methods for UC, and review some of the current treatments being used for UC.

So, what is the microbiota? Microbiota consists of microorganisms, including bacteria, virus, fungi and archaea, that reside in our intestines and they mutually interact with our immune cells in a beneficial manner. The microbiota can easily be influenced by genetic and environmental factors, including diet. There is a delicate balance between the distinct population of microorganisms in healthy individuals; however, patients with UC are found to have an altered gut microbial composition, in which there is an increased potentially aggressive species along with a decrease in anti-inflammatory groups. With this altered gut composition, there is a decrease in gut microbial diversity and an altered metabolic function in patients with UC, which suggests a loss of protective bacteria and their functions. Since intestinal bacteria play such an important role in the development and symptoms of UC, manipulation of the gut microbiota is becoming an active area of research.

The modulation of gut microbiota has been studied through the use of antibiotics, prebiotics, probiotics and fecal microbiota transplantation (FMT), but none have yet been confirmed.





Antibiotics have been used to treat symptoms of UC. When considering the huge diversity of antibiotics used, different methods of administration, and course length, it is difficult to formulate recommendations for clinical practice. Despite some favorable clinical effects, the long-term use of broad spectrum antibiotics potentially eliminates beneficial resident microbiota and decreases bacterial diversity. An additional issue of antibiotics use is the potential of antibiotic resistance, where antibiotics are rendered useless in UC

treatment due to previous and consistent exposure to antibiotics.

Moving on, another microbiota modulator are prebiotics, which are dietary compounds that cause specific changes in the composition and/or activity of the gastrointestinal microbiota. Probiotics are live organisms that beneficially help the host in adequate amounts. In clinical practice, prebiotics and probiotics can provide beneficial effect in UC treatment by altering gut microbiota, but their effects are modest with inconsistent and limited results.

A novel and promising mode of treatment for UC is through fecal microbiota transplantation. Fecal microbiota transplantation (FMT) is a standard treatment for recurrent *Clostridium difficile* infection in the intestines. It involves the transfusion of a biologically active agent (feces) from one person to another, which will ultimately alter one's microbiota. Due to the microbiome irregularity in UC, it was believed that FMT could be an effective treatment for mild-to-moderate UC. However, its efficacy remains controversial. When testing FMT on UC, studies conducted were variable due to different experimental designs, resulting in variable results. More consistent studies are needed to verify its compatibility with UC.

While each treatment has its downfalls, ongoing research is being conducted to find novel treatments that will treat UC. A good start for such treatment is to understand the interactions within the microbiota. Although microbiota communication differs from person to person, it would be necessary to find some kind of personalized microbiota profile to cater to specific microbiota interactions. That way, a set treatment can be used to target different microbiota characteristics and their mechanisms instead of using a broad treatment. I am hopeful that with our current advancements in the field of UC research, a cure can be found!"

Mark quickly walks off the podium after the applause.

"Alright thank you Mark for the wonderful talk! With all this new information about UC thrown at you, I hope you all got something out of it and will leave you motivated to find new cures. Now off to the networking part of the event outside the auditorium."



THE CHALLENGE

Now that you have read through the both cases, what approach will you take in designing a research proposal concerning inflammatory bowel disease? When creating your proposal, try to cover a topic that you feel most passionately about, then ask yourself as many questions as you can about where you can go with it. If none of the cases particularly piqued your interest, it is highly encouraged that you explore further details through your own research! Keep in mind that the cases presented were purely designed for inspirational purposes and do not cover all aspects of UC and Crohn's disease. To summarize, we have compiled the main issues covered throughout the cases in the table below. Further questions to consider are also listed in the adjacent column. To reiterate, you are not limited to these problems alone; please feel free to explore your own ideas!

Problems highlighted	Possibilities to explore
The causes of Crohn's disease and ulcerative colitis remain unknown	Find potential lifestyle, environmental, genetic and biological factors. What are the triggers? What role does the microbiome play in this?
Although distinct, sometimes it can be difficult to distinguish between Crohn's disease and ulcerative colitis	What are differences that can be found in early stages to find the best treatment for patients?
Inflammatory bowel disease highly affects a person's social life and can lead to the development of anxiety and/or depression	How can people who suffer from IBD better cope with this issue?
Antibiotic treatment in inflammatory bowel disease is controversial in many aspects	How can this treatment be improved? Should antibiotics be used at all?
There is no simple way to diagnose IBD	Can serological markers be used to diagnose patients?
There is no way of predicting the onset of IBD	How can better diagnostic tools be developed to catch IBD at earlier stages? How can someone know that they are at a higher risk of developing IBD?