

Do You Know Your Sh*t?

Students' Awareness, Attitude, and Perception about Current and Relevant Events in Microbiology

Keywords: education, fecal transplant, project-based microbiology course, student learning outcomes

ABSTRACT

Aims: To probe the knowledge, insight and attitude of students who had previously taken a traditional microbiology class and those who had not been exposed to any relevant knowledge of microbiology.

Methodology: A total of 228 undergraduate students participated in survey containing 22 questions. The survey collected from 129 nonmicrobiology group (with a 100% completion rate) and 99 were from the microbiology group (with a 90.9% completion rate). The survey focus was on students' general knowledge of bacteria, in particular beneficial bacteria, where they exist, what happens in the lack or absence of them; the usage/misusage of antibiotics; general knowledge about poop, and what it is made of; and fecal transplant as an example of the new medical procedures available today that use live microbes as alternative treatments.

Results: Our results show that current and relevant topics should be included in the curriculum of microbiology courses to motivate students to engage in the learning process.

Conclusion: We conclude this approach will not only inform students about the current knowledge of the field, but will also increase motivation among students which leads to spending more time on task and developing a better understanding of the subject matter and long-term retention of the learned concepts.

INTRODUCTION

PROFESSOR, it seems you know your sh*t... pardon my language"! This is what one of my students told me at the end of a microbiology class. I smiled as I knew what she meant, while I was also thinking that I have finally found the theme for my future SENCER microbiology courses! To design the course, we deliberated and conducted a survey to probe the knowledge, insight, and attitude of students who had previously taken a traditional microbiology class as well as those who had not been exposed to any relevant knowledge of microbiology. This study focused on general knowledge of bacteria, in particular beneficial bacteria, where they exist, what happens in the lack or absence of them; the usage/misusage of antibiotics; the general knowledge about poop, and what it is made of; and fecal transplant, which is one of the new medical procedures available today.

Bacteria are unicellular organisms that are characterized by peptidoglycan cell walls and a single circular chromosome. Without the help of bacteria, the world as we know it would not exist. Bacteria are essential for the life of every multicellular organism. There are more bacterial cells in and on the human body than the number of human cells in the body. The human body contains approximately 10 trillion human cells while playing host to roughly 90 trillion bacterial cells.

These bacteria make up the normal flora of our bodies and are found on our skin, eyes, nose, upper respiratory system, mouth, large intestine, and reproductive organs [1]. Bacteria play important roles in our health from synthesizing vitamins to protecting against possible pathogens through competitive exclusion [2], [3]. Antibiotics often kill not only the targeted bacteria, but other bacteria which are not pathogenic or the intended target of the prescribed antibiotic. Eliminating some bacteria that might be beneficial to the human body could put the body in a situation that leads to other problems. The human body is an ecosystem comprised of a multitude of non-pathogenic microorganisms. By eradicating beneficial bacteria from the human microbiome, we are potentially causing more harm than good.

Alternatives to the use of antibiotics are needed to treat diseases. Overuse and abuse of antibiotics has led to many pathogenic bacteria becoming resistant to antibiotics. Antibiotic resistance is one of the world's pressing

public health problems. One alternative to the use of antibiotics is fecal microbiota transplantation, or FMT, which is used to treat infections caused by *Clostridium difficile*. Fecal microbiota transplantation is one of the new successful alternative approaches for treatment. FMT is a procedure in which donor stool is transplanted into a patient to reestablish the normal microbiota of the colon. Stool is collected from a donor and screened for parasites, bacteria, *Clostridium difficile*, and other potential risks. Donor stool is diluted, strained and transplanted into the patient either by a nasogastric tube, colonoscopy/endoscopy, or enema [4], [5].

Fecal microbiota transplantation is very effective in curing infections caused by *Clostridium difficile*. FMT has a success rate that is over 90% [6]. A randomized study published in January 2013, compared the effectiveness of FMT to vancomycin and to vancomycin with bowel lavage. In that study, cure was defined as having no diarrhea with three negative stool tests for *C. difficile*, while relapse was determined as a positive stool test with diarrhea. The group that was assigned to receive FMT had a cure rate of 81% after the first fecal infusion. After the second infusion, 94% of these patients were cured. Of the patients that received vancomycin only 31% were cured and of the patients that received vancomycin with bowel lavage only 23% were cured. The study was ended early and those that were given antibiotics were offered FMT. The recurrence of infection five weeks after treatment was 6% in the FMT group, compared to 62% in the vancomycin group and 54% in the vancomycin with bowel lavage group [4]. In our study, we surveyed students from both microbiology and nonmicrobiology classes to find out how much they knew about bacteria, antibiotics and fecal transplantation as one of the alternatives to the use of antibiotics for treatment of certain diseases.

METHOD

We created a 22 multiple choice and short essay question survey that questioned the respondents' knowledge of bacteria in general, bacteria in the human body, the respondents' use of antibiotics, and knowledge of fecal transplants as a medical treatment. Surveys were then distributed to students at Harold Washington College in Chicago, Illinois. As data was collected, we separated the surveys into two groups: students who have taken microbiology courses, named the microbiology group, and those who had not, named the nonmicrobiology group. We carefully categorized and analyzed students' responses and drew conclusions from the data collected from both groups.

SURVEY RESULTS

General Results

A total of 228 surveys were conducted with students at Harold Washington College. Of the surveys collected, 129 (with a 100% completion rate) were from the nonmicrobiology group and 99 (with a 90.9% completion rate) were from the microbiology group.

Detailed Results

Whereas the majority, 73.1%, of microbiology group students knew that only a few bacteria are pathogenic, only 22.7% of the nonmicrobiology group students knew this (shown in Fig. 1). Despite background knowledge on bacteria, more than half of both groups agreed that bacteria can become pathogenic if the environment is altered.

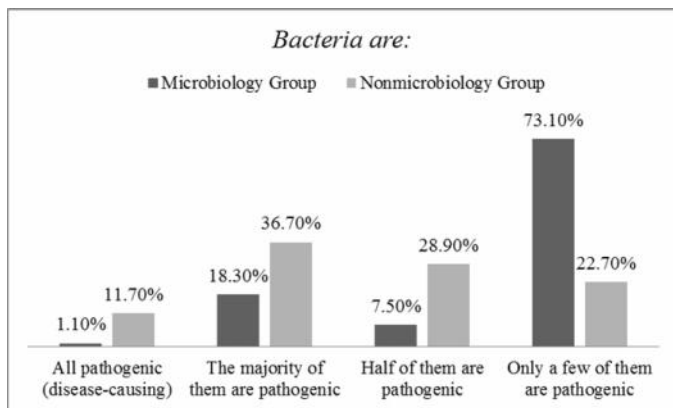


Fig. 1 Student responses to Survey Question 5

More than half of both groups surveyed believe incorrectly that our bodies have more human cells than bacterial cells; 56.2% of the microbiology group students and 68.2% of the nonmicrobiology group students were erroneous. More than 4/5, 82.6%, of students who took microbiology courses thought more bacteria live in the large intestines than any other part of the human body, however less than 1/5, 14.7%, of students who had not taken a microbiology course believed the same (shown in Fig. 2).

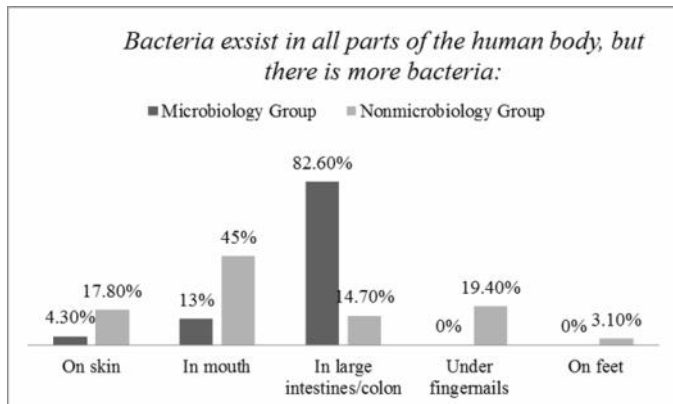


Fig. 2 Student responses to Survey Question 7

Results on questions regarding medication use showed that 47.3% of the nonmicrobiology group students say they take antibiotics almost every time they get sick, or when they get colds or the flu, whereas 88.9% of the microbiology group students said that they take antibiotics very rarely, and only when they will not recover from their illness without them (shown in Fig. 3). 92.2% of microbiology group students indicated that they take antibiotics as prescribed and only when they have infections caused by bacteria, only 52.3% of nonmicrobiology group students stated the same.

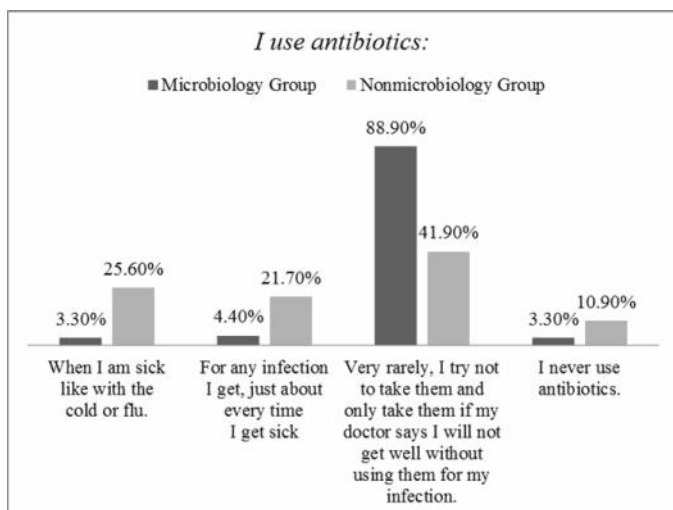


Fig. 3 Student responses to Survey Question 11

Results on questions regarding FMT showed that 57.8% of microbiology group students and 77.2% of the nonmicrobiology group students have never heard of a fecal transplant before (shown in Fig. 4). Only 67.8% of microbiology group students and 34.1% of the nonmicrobiology group students were aware that a fecal transplant is basically a stool transplant. The majority of both groups say that their knowledge of fecal transplant before taking this survey was between 0% - 25%. Only 32.6% of microbiology group students and 21.8% of the nonmicrobiology group students indicated that their knowledge of a fecal transplant before taking this survey was between 50-100%. Roughly half of both groups, 48.9% of students who have taken microbiology and 52.7% who have not, say that they do not have enough knowledge to decide if they would get a fecal transplant if it were recommended by their doctor.

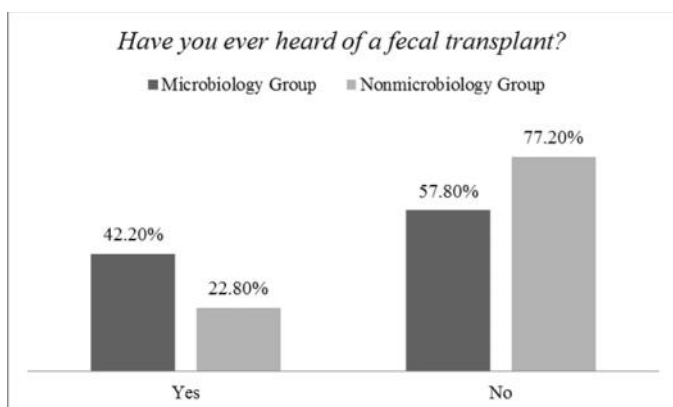


Fig. 4 Student responses to Survey Question 14

The last question on the survey addressed the students' forthcoming educational plans (shown in Fig.5). According to the results of this question, 84.2% of the microbiology group students indicated that they will or may continue with microbiology studies in the future to learn more. Similarly, 70.5% of nonmicrobiology group students stated the same.

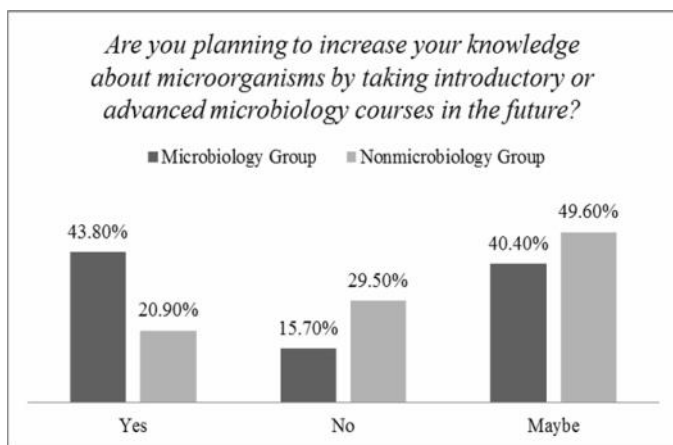


Fig. 5 Student responses to Survey Question 22

ANALYSIS AND CONCLUSION

A recent study shows motivation and study habits are mentioned most frequently as the root cause behind student failure at the college level [7]. “Motivation influences students’ attitudes, study habits, academic readiness, etc. Students who have a good understanding of the content being taught are generally more motivated and have a more positive attitude and thus have a greater chance of doing well in their school work” [7]. The results from our study showed that more than half of the students of both groups were interested in learning more about microbiology. The knowledge that was retained from those who did take microbiology courses was with minor error in comparison to those who did not. More than half, 57.8%, of microbiology group students and over 3/4, 77.2%, of the nonmicrobiology group students have never heard of a fecal microbiota transplant prior to this survey. Incorporating relevant and current topics into a class can generate motivation and spark more interest not only during the class, but also preceding the class. Students will enter the class prepared to talk and learn about the most recent discoveries and be able to apply what they would be learning to their everyday lives. By combining the two, students would be able to see how they can identify and address issues of public concern. The key goal for these classes is to increase motivation and allow the students to engage in the changes that need to be implemented in the sciences so they can participate in the charge of their own education.

Student-based and current topic-based class modification will attract more students to science, technology, engineering, and mathematics (STEM) classes, and open possibilities for those students to educate others on what they believe to be important when it comes to their chosen topic. Using fecal transplants as the topic for a microbiology SENCER class has already sparked interest in students. During their education, students will not only gain experience on the latest learning skills, but will also be prepared to do research independently and with a set goal in mind. Such changes will benefit them and the society in which they live. However, this goal cannot be achieved without a critical look at our existing educational system. Today, this system does not leverage these types of ideas to benefit students and teachers. A majority of the time, classes are taught with material straight out of the textbook. It is rare that a student has input on the course content to include what he or she believes to be an important and interesting topic to study. How can we get students more involved and accountable for their learning? We propose that the way classes are taught needs to be changed. By allowing the student and professor to create a topic that relates to the subject of the class, both the student and the teacher can set goals that will still follow key learning outcomes that need to be taught and incorporate them into the chosen topic. According to the President of the University of Houston, Bill Flores, “we must move from the learner as prisoner (in a system that not only locks in the student, but also the teacher), to the learner as explorer, stimulating their creativity, allowing them to explore new worlds” [8]. Exploring unusual or contemporary

topics (or “New Worlds”) like fecal transplant can stimulate the minds of many students, and motivate students to invest time and energy in their own learning [7].

Our data supports this statement. Roughly 80% of students in each group showed interest in taking a microbiology class after completing the survey. Approaching microbiology from a different perspective can make the class motivating instead of tedious. Using contemporary topics like fecal transplant creates interest in students and changes their perspective of not only microbiology, but the sciences as a whole. What we are trying to do at Harold Washington College is create awareness of research into medical alternatives, and contrast them with traditional forms of medication. Another benefit to this form of teaching is that the topic can relate to an issue going on in their community. For example, many people suffer from *C. difficile* infections, for which antibiotics are commonly prescribed. Fecal transplants have shown promising results and the more people are educated on the subject, the more likely they are to engage their doctors in discussion to find the treatment that is best for them.

In short, we conclude that current and relevant topics are needed to be included in the curriculum of microbiology courses to motivate students to engage in the learning process. This approach will not only inform students about the current knowledge of the field, but will also increase motivation among students that leads to spending more time on and developing a better understanding of the subject matter and long-term retention of the learned concepts. All this will in turn lead to a more positive attitude toward science in general and microorganisms in particular among students. This strategy is one solution to increase the students who enter the STEM fields in the next decade.

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