

The Microbiome, Virome, and Implications for Health

The Microbiome

All of the microorganisms that live in us and on us.

Found on skin and all mucous membranes (GI tract, respiratory tract, genitourinary tract, conjunctiva).

Not found in blood or in tissues (as long as we have no diseases)

10x more microbial cells than human cells ()

These microbes exist in symbiotic relationships with us:

Commensalism – one organism benefits, the other is not affected

Mutualism – _____

Parasitism – one organism benefits, the other is harmed

These microbes are not “passive riders”.

_____.

They protect us from pathogens by occupying spaces so pathogens cannot colonize us.

They produce vitamins ().

They “train” immune system to function properly.

Might be considered another “organ” of our body

Hygiene Hypothesis

We are too clean!

Exposure to environmental microbes and parasites “trains” our immune system to work properly.

Without this microbial exposure we become susceptible to immune disorders like:

Allergies

Type 1 diabetes

Chronic inflammatory diseases

- these are overreactions by the immune system ()

Antibacterial Soaps

Destroy normal flora microbes which normally protect you.

_____.

Key ingredient triclosan leads to antibiotic resistance in bacteria.

Antibiotics

Destroy normal flora bacteria especially in GI tract.

Taking antibiotics often lead to other infections (e.g. yeast infections, *C. difficile*).

GI Tract/Normal Flora (microbiota) – Bacteria

300-1000 different species

Healthy body weight – microbes affect “the harvest, storage (), and expenditure of energy obtained from diet”.

Gut flora of lean individuals differs from obese individuals

Transplanting gut flora from lean mice into obese mice makes obese mice lose weight.

High calorie diets cause gut flora to change.

Immune function – a large part of immune system associated with the GI tract

Mental health – “gut-brain axis”

The microbes in the gut along with the intestines send biochemical signals to the brain ().

Wrong kinds of bacteria or in the wrong proportions may contribute to diseases like Crohn’s, irritable bowel syndrome, and colitis – _____.

Altered gut flora may play role in autism.

“Poop” transplants – feces from a healthy donor can be transplanted into another person
- fecal bacteriotherapy, fecal microbiota transplant

- it replaces missing or lost normal flora bacteria, can restore proper proportions

- _____

The Virome

All of the viruses that inhabit the human body.

Herpes infections may boost immune system and protect us against bacterial infections ().

GI Tract/Normal Flora – Bacteriophages (bacterial viruses)

Most of our normal flora microbes are found in the gut.

Many of these bacteria have the potential to become pathogens ().

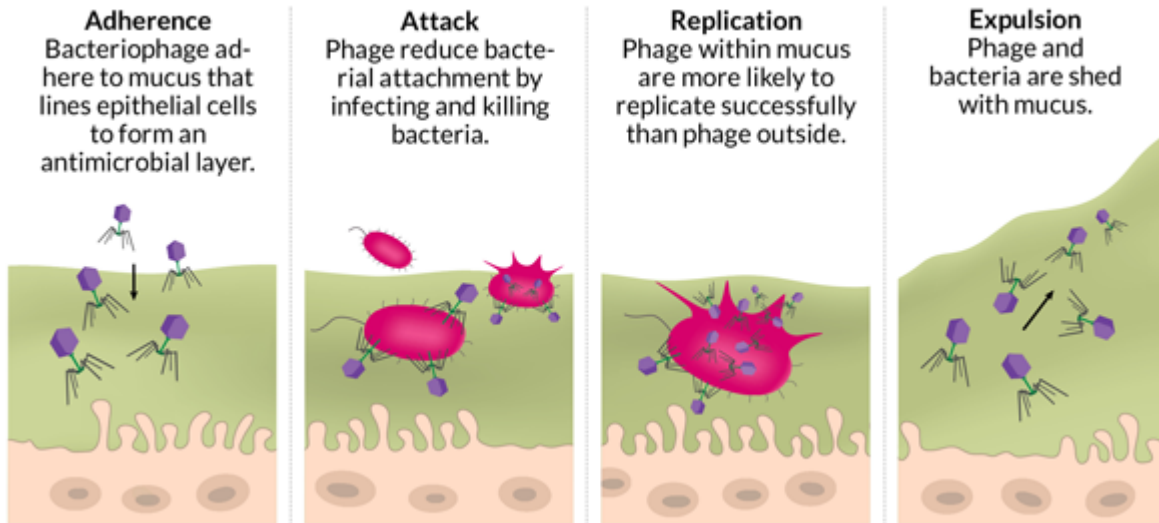
- *E. coli* is very beneficial in the gut but if gets into urethra it causes urinary tract infections ().

All that stands between our bodies and all of those potentially invasive pathogens is a very thin layer of mucus.

How does the mucus stop bacteria from attacking the intestinal wall?

If bacteria reach the intestinal wall, the immune system will try to fight them. This leads to inflammation and tissue damage ().

Within the mucus are many bacteriophages. These bacterial viruses will infect and kill bacteria that try to breach the mucus layer.



This is an example of a “non-host-derived immunity”.

“Magic Bullet”

Theoretically it is possible to create a “broad spectrum” antiviral drug.

LJ001 is a drug that damages lipid membranes of viruses that have them.

It may cause some damage to our cell membranes but our cells can repair them, viruses cannot.

May prove effective against viruses like:

HIV, Influenza, Ebola, Herpes, Hepatitis B, and many others

The problem: If broad spectrum antivirals are successful, we do not know what the consequences will be.

How will the virome and microbiome be affected?

How will we be affected if our normal bacterial and viral flora are damaged or destroyed?

Study Objectives

1. Define the microbiome.
2. Where do we find normal flora? Where do we not find them?
3. Describe the 3 symbiotic relationships.
4. How do normal flora microbes benefit us?
5. Describe “opportunistic pathogen” and give an example.
6. Describe the hygiene hypothesis.
7. Without exposure to environmental microbes and parasites, what kinds of immune problems might occur? Give examples.
8. Describe the problems with using antimicrobial soap and antibiotics.
9. Describe how your gastrointestinal bacterial regulate energy harvest, storage, and expenditure.
10. How can “poop transplants” be beneficial?
11. Describe in detail how bacteriophages protect us from our normal gut flora.
12. What are “magic bullets” for viral infections?
13. Discuss the pros and cons of using broad spectrum antiviral drugs.