



17th Annual Nutrition Forum

Your Microbiome:

The army of microbes that manage your health

(and how you can help them!)

Forum Questions with Answers from Dr. Emma Allen-Vercoe

1. If the gut microbiome is stable over a lifetime, doesn't this argue against an effect of diet on our microbiome?

No. There are essentially 2 measurements of stability in the gut microbiota. One is species composition – this is a catalogue of the species you have present in your gut at any one time. The other is abundance – this is the ratio of the species to each other. Species composition is what we are referring to when we talk about stability over a lifetime. The types of species in your gut remains relatively stable, even if you change your diet. However, the abundance is what gives the microbiota an ability to adapt to diet. The microbiota is actually very dynamic, and will change its configuration in terms of species ratios to most efficiently utilize a food source. Several experiments have shown, for example, that if you change your diet very radically – say from high fibre to high protein – the microbes that utilize fibre as their preferred carbon source will become reduced in numbers, and to fill that vacant niche, the microbes that can use protein efficiently as a carbon source will rise in numbers. But the species composition stays the same because all of these species are present in either scenario.

2. How do you change the microbiome if you have an extinction scenario or repeated hits?

First, not all people who have 'repeated hits' will suffer for it, since everyone is different and some people may either start with an exceedingly diverse microbiome or their microbiome will be perhaps resistant to the insult that would otherwise cause an extinction event. But we can assume that extinction events may take place. If there is not enough functional redundancy (shared function between species) then extinction scenarios are likely to have deleterious outcomes to the microbiome. However, we know very little about this situation, and each person's circumstances and microbiome will be different, so as yet we have no means to predict outcome. What we do know comes from the study of *C. difficile* infection and fecal transplants. Short-term, we know that the missing function of a damaged microbial ecosystem can be at least partially replaced by microbes provided through fecal transplant. But we don't know whether this replacement is permanent (i.e. the new microbes take up residence and stay put) or temporary (the new microbes behave like a Band-aid and hang around until the person's own microbes can recover). The answer is likely to be a mixture of both. Knowing the outcome of fecal transplant is not very possible at the moment as each

donor is different and each patient is different. This is, in fact, what I'm working on in my lab and it's not as easy as you may think! Remember that in a developing microbiome of a baby, there is a kind of turf war going on between the microbes to decide who stays and who goes. We know extremely little about this process. So, changing the microbiome after an extinction event is not an exact science at the moment, and there is the potential to do more harm than good, hence why I am not a fan of fecal transplant for anything except *C. difficile* infection (where we know that there have been extremely significant extinction events, akin to clear-cutting a rainforest).

3. How long does it take for someone to recover from taking non broad spectrum antibiotics if they need to take them several times in one year?

Again, this is not easy to answer because everyone is different, and each antibiotic works in a different way to give different effects. Of the few studies that were done in human volunteers before ethical guidelines suggested it not be such a good idea, recovery to baseline after a single course of antibiotic (several were assessed) took anything from a few weeks to up to 4 years (as measured in one study). So, the answer to this question depends on the microbiome, the antibiotic *and* the patient. One of the findings was, however, that following an exposure to an antibiotic in a patient, the levels of antibiotic resistance genes in the microbiota are increased, and this persists for quite some time – perhaps years. While antibiotic resistance is not great in most circumstances, for the beneficial microbes of the human gut, it may afford them some survival in the face of repeated stresses.

4. Is there any evidence that air pollution exposure affects the microbiome?

Yes. A study by Salim et al. from 2014 (<https://www.ncbi.nlm.nih.gov/pubmed/24637593>) showed that exposure of the gut microbiota to particulate pollutants in the air (through ingestion via food, for example, as well as the deposition of inhaled particulate matter into the esophagus from the mucociliary elevator in the bronchial tubes) did affect the gut microbiota in a negative way, ultimately changing the types of fermentations carried out and reducing the production of beneficial compounds such as butyrate. A great example of this - smoking is associated with altered outcomes in IBD, and while it was not understood why this was until recently, now we know that the effect is likely to be through ingestion of particulate matter and subsequent effects on the gut microbiome. As for which particulates are more important than others, this is an ongoing research focus. Likely the products of combustion (e.g. through burning of fossil fuels) should be considered specially hazardous, however.

5. How does environmental temperature impact gut diversity? Ie: global warming and seasonal changes?

Great question, and I am not sure if the answer is known, only because I am not aware of anyone looking into this. This is partially because even though global temperatures are rising, for the most part the human body is quite adept at keeping the thermostat constant at 37C! As for seasonal changes, I am aware that in many animals there are very dramatic seasonal changes in the gut microbiota, though these can all be explained by dietary changes as different food sources become either available or scarce.

6. What happens to the microbiome after colonoscopy prep? Is the original microbiome restored and if so, how long does it take?

There have been a few studies of this, looking at it from the angle of how a bowel prep may affect results obtained from microbiome studies of biopsy samples. The studies show that immediately after a bowel prep, the diversity of the gut microbiome is reduced. However, remember that this is not the same as antibiotic treatment – instead of being killed, the microbes are being physically removed, but not all of them, and the ones that are left quickly multiply to re-fill the niche. The results seem to show that by 6 weeks after bowel prep, for most people, the gut microbiome has returned to normal.

7. What adverse effects occur in people living on long-term TPN?

There are very few studies looking at this – which is somewhat surprising. The studies that have been done suggest that there are reduced numbers of microbes in the guts of TPN patients during treatment, although that is not surprising. TPN seems to be very effective for treating severe Crohn's disease, and the mechanism may be through the monotony of the treatment, that tends to prevent outgrowths of certain microbes that would otherwise exacerbate symptoms. I know of a researcher who is interested in how the use of TPN in trauma patients may create problems because of the sudden change in the microbiota after a dramatic dietary shift. But I am not aware of any results from that study yet. Here is a recent review of the TPN/microbiome topic: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4245590/>

8. From your point of view, would you consider obesity a disease?

A tough question. I would say that I consider obesity to be the result of a metabolic imbalance in the microbiota often combined with a poor diet and exacerbated by lifestyle choices that are less than optimal. Obesity results in a much higher chance of developing many other diseases from diabetes to depression. I guess I consider obesity to be the start of a slippery slope.

9. Have you written a book?

No. I have a whole novel idea in my head waiting to get typed up, one day, but I rarely have time for writing anything outside of science, so it will be a project for another day! As for writing about my science, I think there is a real glut of excellent books out there, and I couldn't do any better than them. I have co-edited a book, however:

<http://www.destechpub.com/product/human-microbiome-handbook/>

10. Science and public health messaging that is transformational, clear, and consistent seems imperative- how can we all help to develop and implement this strategy for knowledge translation?

Volunteer for public outreach at every opportunity; consider it part of your job to pass your knowledge on to others. But more than that, fight misleading messaging wherever and whenever you see it. Implore patients to turn to science to help them decide whether to purchase a supplement or not, rather than trashy magazines or websites. Keep up to date with what is going on in your field as well as peripheral fields. For the microbiome I recommend the Microbiome Digest:
<https://microbiomedigest.com/>