



Fecal Microbiota Transplants: The Ins and Outs of FMT

Ed Yong: *Clostridium difficile*, or *C. diff*. A nasty, weedy bacterium that can cause chronic, painful diarrhea. In the U.S. every year, hundreds of thousands of people are infected by *C. diff*, and tens of thousands die from it. And often, people get it after taking antibiotics. But scientists have finally found a material that can cure *C. diff* infections. And that material is ... poop.

[Bubbly liquid sound]

Mark Smith: Ah, we call it mostly poo.

Ed Yong: This is Mark Smith, a microbiologist and founder of a nonprofit called Open Biome, based in Massachusetts. He is one of many scientists who are trying to fight *C. diff* infections through a rather unorthodox treatment called ...

Mark Smith: Fecal microbiota transplantation.

Ed Yong: Or FMT. The M can stand for microbiome or microbe. The T sometimes stands for therapy or treatment. But the F? The F always stands for feces.

Mark Smith: We're taking stool, ah, we're processing it and extracting the bacterial component.

Ed Yong: So you're taking poop from a healthy person and you're putting it into a sick person. Who came up with this idea?

Mark Smith: Yeah this has been used as a medical therapy, ah you know, dating back to ancient Chinese medicine. This idea of ah, human feces that would be delivered in a yellow soup to treat digestive diseases.

Ed Yong: In the 1950s, reports started coming in about the successful use of fecal transplants to treat a variety of different conditions. And then in the late two thousands, many doctors independently started using FMT to treat seemingly incurable *C. diff* infections. Clinical trials began, and hundreds of people were successfully treated.

Ed Yong: So, Mark, how does a dose of poop cure *C. diff*? What's going on in there?

Mark Smith: So, you know, when I think about the microbiome, I think about it as this, this chaotic, uh, little city within us. You have some bacteria that are blooming, others that are dying, sort of this, you know mad mini civilization that's going on.

Ed Yong: And what happens to this civilization when you take a long, powerful course of antibiotics?

Mark Smith: You know, imagine there are, like, bad guys on the loose and we said, uh "You know what? We've just gotta nuke them and like, get rid of everybody that's living here. That's kind of the approach that we're taking with a lot of these bacterial infections, where rather than just going after the bad guys, we're going after everybody.

Ah, and you know then all of a sudden, you've got this, sort of, postapocalyptic nightmare afterwards, where you've killed all the, not just the bad bacteria that were causing your infection, but also, you know, a lot of the, the good guys, and ah, and in this environment, ah you know, a lot of bad guys emerge and sort of loot the city that's leftover.

Ed Yong: So in a healthy person, this rich, thriving community of bacteria keeps *C. diff* in check.

Mark Smith: Yeah, and when those bacteria are disrupted or eliminated by antibiotic exposure, that opens up this niche space for *C. diff* to go in and take advantage, multiply its population size.

Ed Yong: And so when you give people a dose of poo, you are reintroducing all of those missing bacteria.

Mark Smith: You know, it's comprised of thousands of different strains of bacteria. And they're all regulating each other and changing their behavior in real time.

Ed Yong: It's like an ecosystem transplant.

Mark Smith: Exactly, Ed

Ed Yong: And Mark, fecal transplants are really effective right? They're the best bet for some *C. diff* patients.

Mark Smith: Fecal transplantation works ah well, it works about 85% to 90% of the time in these patients that otherwise failed to respond to antibiotics, so these are the sickest of the sick patients. You know, chronic diarrhea, they're having, you know, ten, twenty bowel movements every day, maybe for months. They will usually within a couple of days be back to normal, and it's amazing when you talk to these patients.

Ed Yong: Open Biome is one of a growing number of nonprofit stool banks that collect, process, and distribute stool for fecal transplants. Most of it comes from local college students who make 40 bucks per ... deposit.

[Nurse: Do you have your donation card?]

Ed Yong: The screening process is rigorous. The chance of passing on a disease must be minimized. So you can't be on any medication or have traveled overseas where you could have picked up a dangerous pathogen. Less than five percent of people pass and become donors.

Ed Yong: In this lab, they turn the stool into medicine.

Mark Smith: It starts off as the poo that we all know and love (laugh). Some of us maybe love more than others.

And then we add a cryo-protectant to protect it from the freezing process and an osmo-protectant to protect it from the cells bursting from being exposed to water. And that sort of dilutes it up and turns it more into more of a liquid slurry (laugh). Ah and then it gets pushed through a filter to remove the fibrous materials. Then it's a really thin liquid, still a thin brown liquid and ends up looking a lot like chocolate milk. You can think about Charlie and the Chocolate Factory, the big chocolate waterfall. We've got a much thinner one of those. That is our kind of core process.

Ed Yong: The fecal matter is then placed in plastic containers, frozen, and sent out. Hospitals then deliver it into patients either by colonoscopy, or by a tube that goes down their nose into their gut. Or, most simply, by a pill. A pill filled with poop.

Ed Yong: Fecal transplants work really well for treating *C. diff*, but what about other conditions?

Mark Smith: We're looking at ulcerative colitis. We're looking at Crohn's disease. We're looking at pouchitis. We're looking at irritable bowel syndrome. We have work in obesity.

Ed Yong: But in clinical trials of other conditions, fecal transplants have not been as effective

Ed Yong: Still, scientists like Mark are hopeful that with more research, they will become a new way of treating disease.

Mark Smith: Yeah, yeah. Exactly.

Ed Yong: By harnessing the power of poop.

Mark Smith: The most gratifying part of my day is to see a big pile of boxes there filled with dry ice and poo, and going out to hospitals and clinics all over the country.

Ed Yong: Fecal transplants are bizarre. They are revolting. They are implausible, and yet they work. And they reveal the power of the microbiome. Perhaps it's time for us all to start giving a (beep).

Ed Yong: Congratulations on making it through the grossest episode of our season ... so far. Does the idea of a poop transplant gross you out, or do you think it's going to be the next big breakthrough in medicine? Let me know in the comments below.

END OF EPISODE