

Faeces-filled pill stops gut infection

Treatment halts recurrence of *Clostridium difficile* bacteria, but a commercial pill is still far off.

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Clostridium difficile bacteria sickens roughly a half million people in the United States each year.

Patients with a stubborn, debilitating bacterial infection may soon be treated with pills full of microbes derived from human faeces.

Clostridium difficile is a bacterial infection that causes diarrhoea and fever in around half a million people in the United States each year, and is linked to the death of some 14,000 US citizens annually. Some physicians now treat recurrent *C. difficile* infections with faecal transplants, delivering donor faeces filled with healthy microbes via enemas, colonoscopies or nasal tubes that run directly to the gut.

But capsules containing the same donor bacteria are also effective at giving these 'gut microbiome transplants', according to results presented on 3 October at a meeting in San Francisco, California.

Thomas Louie, an infectious-disease specialist at the University of Calgary in Alberta, Canada, treated 31 patients with the bacterial pills, curing all but one. Because the pills are less invasive than other techniques for treating the disease, they could make gut microbiome transplants available to more patients — including those who, for medical reasons, cannot tolerate an enema or tube from the nose to the small intestine. Louie had initially created the capsules when treating such a patient.

C. difficile often sets in after antibiotic use has disrupted a person's normal balance of gut bacteria. A gut microbiome transplant using bacteria from the faeces of a healthy donor restores that balance, and can be highly effective against *C. difficile*, which is notoriously difficult to treat with antibiotics.

Gut reaction

The patients in Louie's study each swallowed 24–34 freshly assembled capsules of bacteria, which were coated with gelatin to survive the stomach and reach the intestines. The team followed the patients' progress for up to one year afterwards by sequencing the gut microbiome. They found that *C. difficile* had disappeared and bacteria associated with a healthy gut microbiome, such as *Bacteroides*,

Clostridium coccooides, *Clostridium leptum*, *Prevotella*, *Bifidobacteria* and *Desulfovibrio*, increased in numbers.

"This pill idea really is a big advance," says Colleen Kelly, a gastroenterologist at Brown University's Alpert Medical School in Providence, Rhode Island, who performs faecal microbiome transplants using colonoscopy.

A pill made of bacteria grown in a laboratory rather than those extracted from donor faeces is a future possibility, and Louie says that he has been contacted by parties interested in commercializing his pill. He adds that his team is currently experimenting with freezing bacteria for *C. difficile* treatment.

However, economic barriers to such a synthetic pill are significant. Elaine Petrof, an infectious-disease expert at Queen's University in Kingston, Ontario, has created RePOOPulate, a mix of 33 different types of bacteria grown in the lab to mimic the microbiome¹. Her team spent two years getting the equipment to grow the bacteria up and running, but the process is still expensive and the bacteria finicky. "Honestly, good luck to you," she says to companies trying to commercialize the technology.

The high cost of producing bacteria in this way would be less of a barrier if the alternative were not so cheap. As Tom Moore, a physician and infectious-disease specialist in Wichita, Kansas, puts it: "It'll be difficult to compete with the ready availability and very cheap costs of human poop."

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References

1. Petrof, E. O. *et al. Microbiome* **1**, 3 (2013).