

# Robotic Pills for Gastrointestinal-Tract-Targeted Oral mRNA Delivery

Internal Auto-injecting Pill Poses New Mechanism of Administration

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*So many Americans want to put mRNA out of their minds after the COVID-19 vaccine debacle. Dreams of injections gone bad with side effects including heart attacks, strokes, blood clots, and nerve damage have so many people around the world fearful of the next technological step. On cue with a bad dream Tao and coworkers from Harvard published on a "mechanical pill" to directly inject the stomach lining. If this was a sci-fi movie, people would be heading for the exits!*

## Matter



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Previews

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### Previews

## Robotic pills for gastrointestinal-tract-targeted oral mRNA delivery

Wei Tao<sup>1,\*</sup> and Nicholas A. Peppas<sup>2,3,4,5,6,\*</sup>

mRNA has become a new class of therapeutics and vaccines that possess high efficacy for the treatment and prevention of a variety of diseases. Recently, a team led by Professors Traverso and Langer, pioneers and leaders in the field of drug delivery and biomedical devices, reported the design and use of robotic pills for gastrointestinal-tract-targeted oral mRNA delivery, opening up a new avenue for the oral mRNA medicines.

mRNA. The top-performing mRNA-loaded PBAE nanoparticles were then lyophilized, concentrated, and filled into the robotic pill called Self-Orienting Millimeter-Scale Applicator (SOMA). Upon oral administration, the robotic pills quickly entered the stomach, where they could self-orient to allow the direct injection of mRNA nanoparticles into the stomach submucosa for robust mRNA expression, bypassing the natural barriers existing in the gastrointestinal (GI) tract. This study

In addition to the oral delivery of mRNA, the SOMA robotic pills can also be used for the oral delivery of other macromolecules. The oral delivery strategy has the advantages of superior convenience and patient compliance.<sup>3–5</sup> For example, Abramson et al. previously described the oral delivery of insulins using the SOMA robotic pills.<sup>6</sup> In this study, the

Therefore, a well-designed robotic pill system enables the oral delivery of mRNA to the GI tract, providing a simple and non-invasive approach for mRNA delivery, and might eventually benefit the rapid development of novel mRNA therapeutics and vaccines.

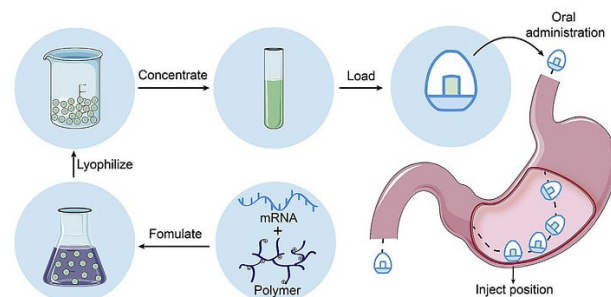


Figure 1. The preparation of mRNA-loaded robotic pills, which are administered orally to bypass the natural barriers existing in the gastrointestinal tract

The authors summarize the technology in this key figure. In a nutshell, a pill would be swallowed and the devices would orient to the wall of the stomach or intestine (which would be difficult to control) and then the payload (mRNA) would be injected into the gastrointestinal epithelium and submucosa. The rich blood supply would immediately take the products into the blood stream. From there, the portal circulation would take blood to the liver via the hepatic portal vein. No one knows what a direct shot of mRNA would do to the liver. I can tell you as a doctor, I would be very concerned this could lead to even bigger complications than injection in the arm. Let's hope this remains a bad dream for now.

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