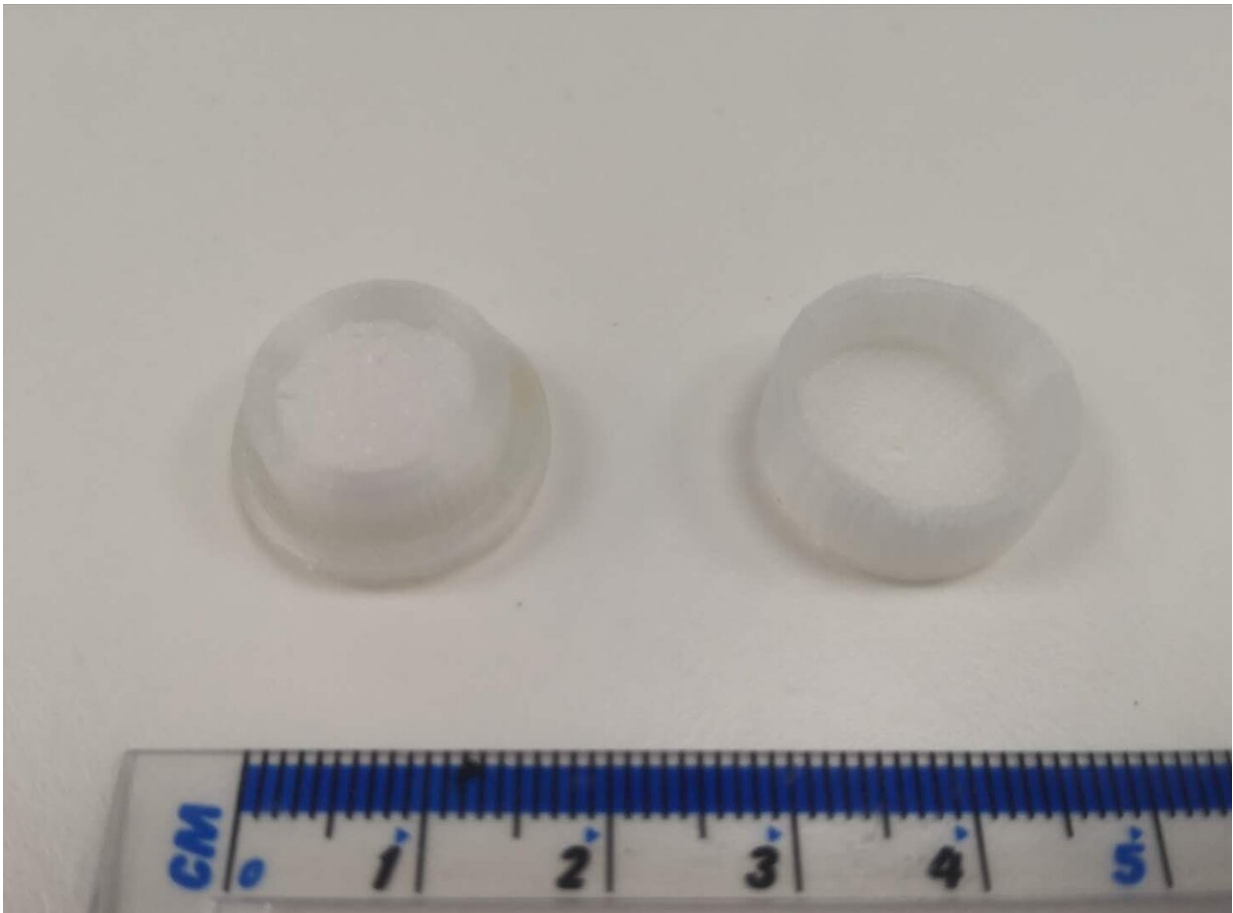


How magnetic fields and 3-D printers will create the pills of tomorrow

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3D printed reservoir used for placing the magnetically actuated sponge and drug to be delivered upon applying a magnetic field. Credit: University of Sussex

Doctors could soon be administering an entire course of treatment for

life-threatening conditions with a 3-D printed capsule controlled by magnetic fields thanks to advances made by University of Sussex researchers.

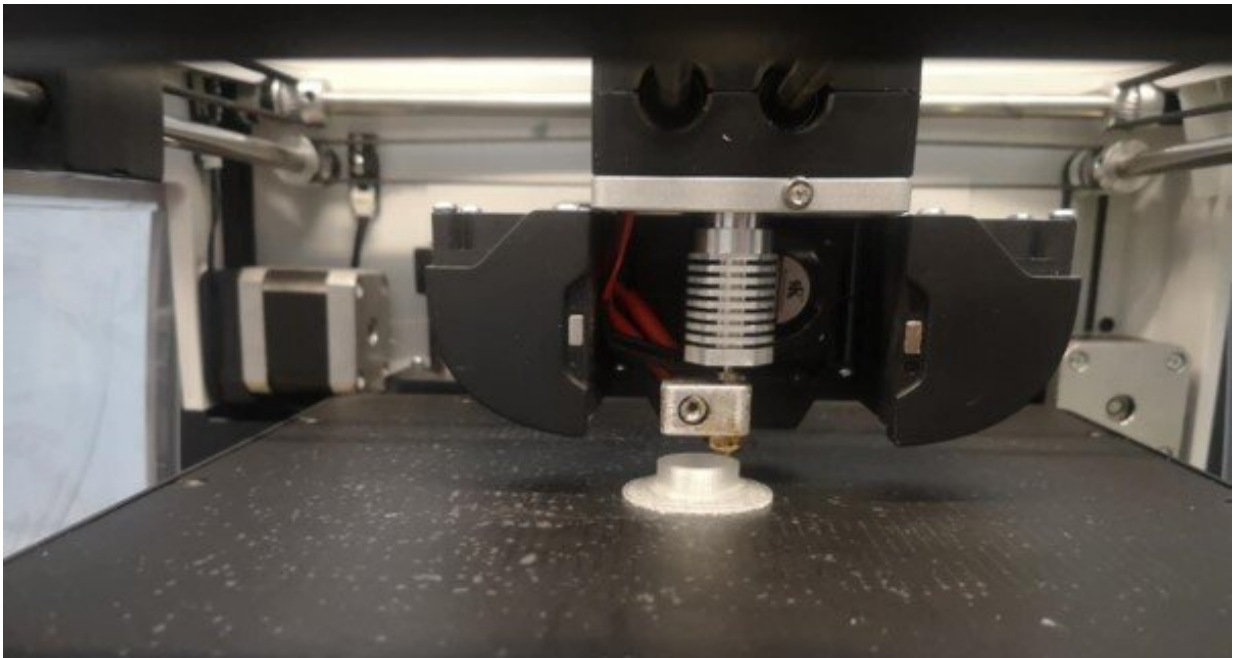
Engineers and pharmaceutical scientists from the University of Sussex and The University of Texas at Austin have developed a triggerable and remotely controllable system for on-demand drug delivery.

Using 3-D printing technology and magnetic actuation, researchers have been able to prove the concept of a drug release triggered by magnetic fields capable of inhibiting the proliferation of cancer cells *in vitro*.

While the research is in its initial phases, the researchers are working towards a system where it is possible to drive the [drug delivery system](#) towards the required position in the body using external means such as permanent magnets. The technology would allow for a drug to be applied close to the lesion.

The researchers foresee that the targeted delivery offered by the new system could help eliminate harmful side effects caused by treatments like chemotherapy which damage neighboring healthy cells. The device also offers a level of control that would guard against inappropriate dosing which has become the main cause of adverse effects from [drug therapy](#).

Kejing Shi, doctoral researcher in the University of Sussex's School of Life Sciences and lead author of the study, said: "The device offers the potential for personalized treatment through the loading of a given drug in a particular concentration and releasing it within different dosage patterns. All results confirmed that the device can provide a safe, long-term, triggerable and reusable way for localized disease treatments such as cancer."



Fabrication of the device reservoir using a standard 3D printing machine. Credit: University of Sussex

Professor Ali Nokhodchi, head of Pharmaceuticals Research Lab at the University of Sussex School of Life Sciences and corresponding author of the article, said: "The device delivers enhanced efficacy and safety through optimal drug distribution and absorption in the targeted location at the (sub)cellular level. This device has the potential to be used in treatments for cancer, diabetes, pain, and myocardial infarction which require variable release kinetics where patients' suffer from discomfort or inconvenience if they currently rely on untunable monotonic drug treatment."

In the study, to be published in the August edition of *Colloids and Surfaces B: Biointerfaces*, a device containing anticancer drug 5-fluorouracil and composed of a magnetic polydimethylsiloxane

(PDMS) sponge cylinder and a 3-D printed reservoir showed an inhibition effect on Trex cell growth.

Repeated, localized drug release was achieved by switching the applied magnetic field on and off. Varying the intensity of the magnetic field when applied to the device causes the internal magnetic sponge to be compressed at different ratios, which releases different amounts of the drug.

In vitro cell culture studies demonstrated the stronger the [magnetic field](#) applied, the higher the drug release and the greater inhibition effects on Trex cell growth.

The researchers say that this kind of smart treatment could be available for patients in hospitals within a decade.

Dr. Elizabeth-Rendon Morales, Senior Lecturer in Engineering at the University of Sussex's School of Engineering and Informatics, said: "Fine tuning and characterizing the device performance allows the system being capable of releasing the [drug](#) within different dosage patterns thus, having the potential to offer personalized treatment."

Dr. Rodrigo Aviles-Espinosa, a Lecturer in Biomedical Engineering at the University of Sussex's School of Engineering and Informatics, says "Advancing this process further, we could create different compartments in the capsule with different sponges or employ other techniques where the macroporous sponge properties can be tailored to hold two or more substances without being mixed which could deliver more complex courses of treatment."

More information: Kejing Shi et al, Novel 3D printed device with integrated macroscale magnetic field triggerable anti-cancer drug delivery system, *Colloids and Surfaces B: Biointerfaces* (2020). [DOI:](#)

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