

DNA computer brings 'intelligent drugs' a step closer

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Researchers at Eindhoven University of Technology (TU/e) present a new method for controlled drug delivery into the bloodstream using DNA computers. In the journal *Nature Communications*, the team, led by biomedical engineer Maarten Merkx, describes how it has developed the first DNA computer capable of detecting several antibodies in the blood and performing subsequent calculations based on this input. This is an important step toward the development of smart drugs for better delivery of medication for conditions such as rheumatism and Crohn's disease, with fewer side effects and at lower cost.

An analogy for the method presented by the TU/e researchers is a security system that opens a door after identifying the person standing in front of it. If the camera recognizes the person, the door unlocks, but if the person is unknown, the door remains locked. "Research into diagnostic tests tends to focus on the recognition, but what is special about this system is that it can think and that it can be connected to actuation such as drug delivery," says professor of Biomedical Chemistry Maarten Merkx.

DNA computer

To be able to perform such an action, intelligence is required, a role that is performed in this system by a DNA computer. DNA is best known as a carrier of genetic information, but DNA molecules are also highly suitable for performing molecular calculations. The sequence within a

DNA molecule determines the other DNA molecules with which it can react, and can be programmed for desired reaction circuits.

Antibodies

To date, biomedical applications of DNA computers have been limited because the input of DNA computers typically consists of other DNA and RNA molecules. To determine whether someone has a particular disease, it is essential to measure the concentration of specific antibodies. Merkx and his colleagues are the first to have succeeded in linking the presence of antibodies to a DNA computer.

Drug delivery

Their method translates the presence of each antibody into a unique piece of DNA. The DNA computer can decide on by detecting the presence of one or more antibodies whether [drug delivery](#), for example, is necessary. "The presence of a particular DNA molecule sets in motion a series of reactions whereby we can get the DNA computer to run various programs," explains Ph.D. student and primary author Wouter Engelen. "Our results show that we can use the DNA [computer](#) to control the activity of enzymes, but we think it should also be possible to control the activity of a therapeutic antibody."

Medication

In treating chronic diseases like rheumatism or Crohn's disease, such [therapeutic antibodies](#) are used as medication. One of the potential applications of this system is to measure the quantity of therapeutic antibodies in the blood and decide whether it is necessary to administer any extra medication. Merkx says, "By directly linking the measurement of [antibodies](#) to the treatment of the disease, we may be able to prevent

side-effects and reduce costs in the future."

More information: *Nature Communications*, [DOI: 10.1038/NCOMMS14473](https://doi.org/10.1038/NCOMMS14473)

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