Paper-based synthetic gene networks could enable rapid detection of Ebola and other viruses

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Synthetic gene networks hold great potential for broad biotechnology and medical applications, but so far they have been limited to the lab. A study published by Cell Press October 23rd in the journal *Cell* reveals a new method for using engineered gene circuits beyond the lab, allowing researchers to safely activate the cell-free, paper-based system by simply adding water. The low-cost, easy-to-use platform could enable the rapid detection of different strains of deadly viruses such as Ebola.

"Our paper-based system could not only make tools currently only available in laboratory readily fieldable, but also improve the development of new tools and the accessibility of these molecular tools to educational programs for the next generation of practitioners," says senior study author James Collins of the Wyss Institute for Biological Inspired Engineering at Harvard University.

The field of synthetic biology aims to re-engineer the molecular components of the cell to harness the power of biology. To accomplish this goal, researchers have designed synthetic gene networks that can control the activity of genes and recognize nucleic acids and small molecules. However, this technology has been restricted to the lab, in part because of biosafety concerns associated with cell-based systems and because the reactions involved have not been practical for field use.

Collins and his team overcame these hurdles by developing a cell-free,

paper-based system suitable for use outside the lab. To test the clinical relevance of their method, the researchers developed sensors capable of detecting RNA molecules made from genes that allow bacteria to survive antibiotics, as well as RNA molecules encoding proteins from two different strains of the highly deadly Ebola virus. When freeze-dried onto paper, the sensors quickly detected the presence of these RNA molecules, demonstrating the usefulness of the approach for diagnostic purposes.

"Considering the projected cost, reaction time, ease of use, and no requirement for laboratory infrastructure, we envision paper-based synthetic gene networks significantly expanding the role of synthetic biology in the clinic, global health, industry, research, and education," Collins says.

More information: *Cell*, Pardee et al.: "Paper-based Synthetic Gene Networks." www.cell.com/cell/abstract/S0092-8674(14)01291-4

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