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With A Twist, Chip Measures Viral Loads

Medical Diagnostics: New device measures a wide range of concentrations of viral RNA in blood

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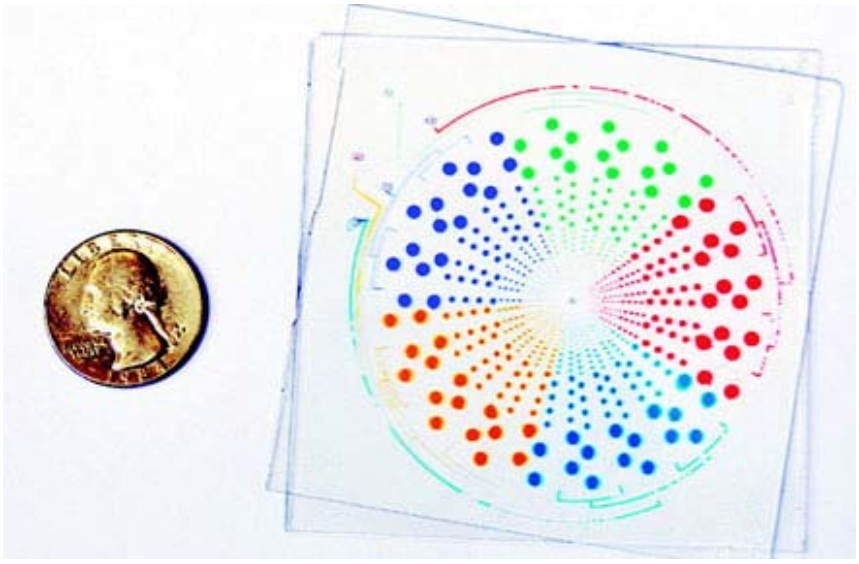

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Seeing Spots At first, the SlipChip consists of two glass plates with a series of overlapping, multi-sized wells. After a small twist of the plates, the wells separate from each other to produce offset wells (shown).

An inexpensive microfluidic device that measures viral RNA levels in blood could help doctors in developing or remote regions treat patients infected with HIV or other viruses (*J. Am. Chem. Soc.*, DOI: 10.1021/ja2060116).

Doctors assess the severity of a viral infection or the effectiveness of treatment by estimating the amount of virus in the body, says Feng Shen of SlipChip, the company that is developing the new device. However, the gold standard for measuring viral load, quantifying RNA concentrations with a real-time polymerase chain reaction, requires costly instrumentation.

In 2010, when Shen was at the University of Chicago, he, Rustem Ismagilov, and their colleagues designed an inexpensive alternative method based on a microfluidic chip that the Ismagilov lab had invented called the SlipChip. Their chip consists of two glass plates, each etched with 320 wells divided evenly among four volumes: 1, 5, 25, and 125 nL. The researchers stack the plates so that their wells overlap, allowing a doctor to fill all of the wells at once.

To measure viral loads with the chip, a doctor would first purify the RNA from a patient's blood and then mix it with a set of reagents. After loading that mixture into the SlipChip, the doctor would twist the chip's top plate by 8° to separate its wells from the lower ones, creating and sealing off 640 isolated wells. At low concentrations, smaller wells might carry no RNA molecules. If viral RNA were in a well, the reagents would convert it to DNA and amplify that DNA. Another reagent, a fluorescent dye, then would label the DNA. Based on the number and volume of the glowing wells, computer software would calculate the starting concentration of viral RNA.

The researchers tested the device with solutions containing known concentrations of viral RNA as well as with blood samples from patients with HIV. The concentrations matched those obtained from real-time PCR. The SlipChip measured a wide range of concentrations of viral RNA, from 520 to 4 million molecules per mL. Detecting such a range is important in the clinic, Shen says. It's unclear how much a market-ready device will cost, Shen says, but it will be much cheaper than current technologies.

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