Medical researchers open eyes to tiny laboratories on a chip

Technology that shrinks laboratory procedures to the size of microchips is beginning to find applications in biomedical research, from counting HIV-infected cells to filtering harmful fats from the blood.

By borrowing techniques used to make microelectronics, chemists and engineers have spent several years building prototype 'labs on a chip.' The devices, carved from materials such as silicon, carry out bench experiments in miniature mixing chambers as small as a single cell.

Once considered cute curiosities, the gadgets are now being adopted by medical researchers and clinicians. They can process a tiny sample through multiple steps without human intervention, saving costly reagents, time and labor. "Now people are moving into true biology," says Thomas Laurell, who studies nanotechnology at Lund University in Sweden.

One team, involving researchers at the University of Texas in Austin and Massachusetts General Hospital in Boston, has devised a small appliance for counting the disease-fighting $CD4^+$ cells that are destroyed by HIV. Such counts are vital to gauge when a patient should begin antiretroviral treatment, and are currently carried out using a cumbersome flow cytometer costing at least $60,000 and confined to medical clinics.

The new device processes a single drop of blood on a tiny single-use chip. Once the blood is added to the chip, it flows through a series of reaction chambers where a fluorescent label recognizes and attaches to proteins on the surface of $CD4^+$ cells. The chip sits in a machine about half the size of a toaster, which tallies up the labeled cells.

The portable device can be used in remote locations and will sell for about $1,500 when it becomes available later this year, says Rick Hawkins, chairman and CEO of the company marketing the technology, called LabNow, in Austin, Texas. The team members say they are adapting the technology to take other measurements such as the viral load in blood.

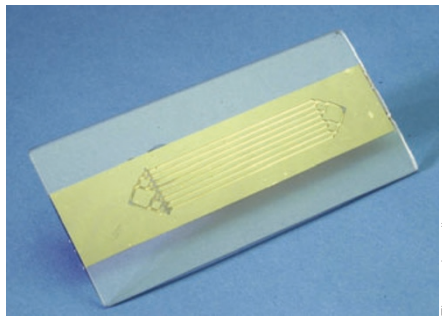
Laurell's group has developed a chip the size of a postage stamp for combating a perennial problem encountered during surgery using a heart-lung machine. Sometimes, lipids leak into the blood from fat tissue damaged during the operation and cause tiny clots to form in the blood vessels of the brain. Methods currently used to filter out these lipids are not completely effective and can damage blood cells.

In the new system, blood flowing through a channel is subjected to sound waves that exert pressure on the blood cells and lipid particles. Because the two components are different densities and respond differently to the pressure, they move in different directions and into separate tubes (*Lab Chip* **5**, 20–22; 2005). Laurell's group is scaling up the technology to filter liters of blood by using multiple chips in parallel.

Though many of these devices have yet to find a commercial market, the technology is coming into its own in basic research. Miniature machines for culturing cells, for example, are thought to mimic the subtle microenvironment around cells better than conventional culture dishes. Researchers have grown single neurons on a chip and measured their electrical activity (*Lab Chip* **5**, 97–101; 2005) and measured insulin secretion from pancreatic cells (*Lab Chip* **5**, 56–63; 2005).

But despite their progress, those in the field say the technology is still some way from being widely accepted by researchers and doctors, who are often reluctant to give up tried and tested techniques. "Not only do you have to show that you can do it better and cheaper," says biomedical engineer David Beebe at the University of Wisconsin, Madison, "but you have to get doctors to change the way they do medicine."

Charlotte Schubert, Washington DC



Thomas Laurell

Diminutive device: Tiny channels on this chip can filter dangerous fats from the blood.

Action plan peps up Europe's mental health

In an attempt to tackle Europe's rocketing rates of depression, anxiety and suicide, the World Health Organization (WHO) launched an action plan in January to bolster mental health treatment and research.

The plan was adopted by 52 countries attending a WHO European Ministerial Conference on Mental Health in Helsinki, Finland. It is the first region-wide effort to tackle mental illness and is expected to pave the way for similar schemes in other parts of the world.

The 12-point strategy spells out ways for member countries to better recognize, prevent and treat oft-ignored mental health problems. "It's the first time there's been a broad view on mental health," says Paul Schnabel, head of the Social and Cultural Planning Office of the Netherlands, a policy research organisation based in The Hague.

Europe has some of the highest incidence of mental illness in the world, and experts have struggled to explain why. Lithuania, for example, has the top rate of suicide, and Denmark, Finland and Hungary rank close behind.

The new plan urges countries to make mental illness an integral part of existing public health policies and to increase access to information and care. It also calls for more rigorous, long-term studies to establish the safety and effectiveness of some mental health policies and treatments, such as moving patients from institutions to community-based care. This type of research has been limited because it is difficult to measure small improvements in mental illnesses.

Neuroscientist Colin Blakemore, head of the UK's Medical Research Council (MRC) in London, welcomes the research proposals in the action plan. He says that they mirror those in a review of the MRC's own research efforts into mental health, which is due to be released in April. The WHO document, for example, encourages research collaborations that span academic disciplines, such as psychology and anthropology, and that cross European borders.

But some medical researchers criticized the plan for ignoring basic research they say is needed to understand the causes of schizophrenia, depression and other conditions. Brain researcher Steven Rose at the Open University in Milton Keynes, UK, says that large epidemiological studies are needed to find out, for example, why depression and anxiety are on the rise.

In order to improve treatment, researchers say that European nations need to expand studies into immunology, genetics and brain imaging, which are beginning to pinpoint the molecules and brain regions underlying such disorders. These approaches, "offer the possibility of completely new approaches to treatment," Blakemore says.

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