Better vaccinations

Hypodermic needless

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How to improve the delivery of vaccines

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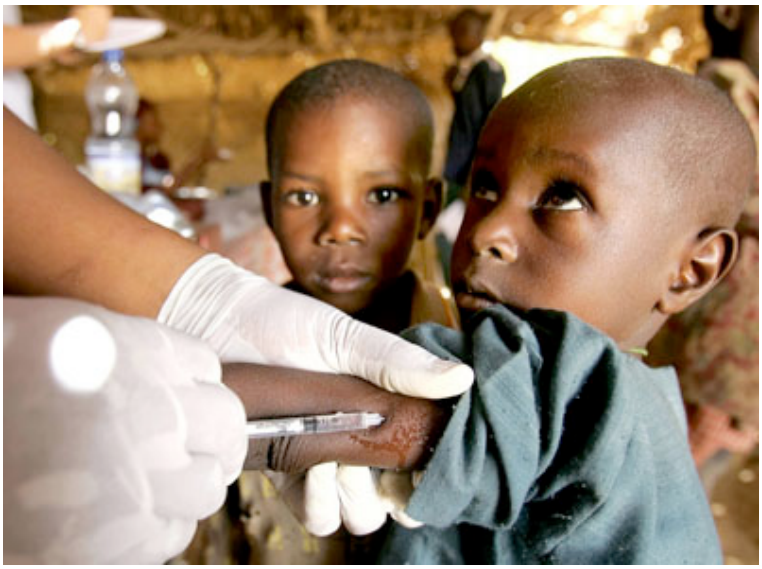

VACCINATIONS are a pain. Any two-year-old with access to reasonable health care will tell you that. But injections are bad for reasons other than the discomfort they cause. If syringes are reused without sterilisation, they can spread disease. The liquid vaccines they require are often temperamental, needing constant refrigeration and thus what is known as a "cold chain" to keep them in tip-top condition as they move from factory to clinic. And hypodermic needles do not even deliver vaccines to the best place in the body.

Vaccines work by activating the immune system. For that to happen, they have to meet up with what are known as antigen-presenting cells. These cells recognise alien invaders, chop them up and then carry characteristic bits of them to the rest of the immune system so that the invader can be recognised and appropriate measures taken. If an invader is new, this process allows the immune system to learn to recognise it, and respond more rapidly next time. A vaccine (which contains either a dead or an attenuated form of a pathogen) lets the immune system learn about a disease without the body having to undergo the infection. But antigen-presenting cells tend to congregate in places where pathogens arrive, such as the lungs and the skin—not in the muscles where the tip of a hypodermic needle ends up.

How to improve this state of affairs was the topic of two talks at this year's meeting of the American Chemical Society, in Washington, DC. Both proposals eliminate the need for painful needles and the need to transport liquids around. And both deliver their cargoes to places where antigen-presenting cells abound.

Just breathe deeply

Robert Sievers of the University of Colorado is working on a new way to deliver a vaccine for measles. Vaccination against this disease has become controversial in effete Western circles because of the malign effects of one or two hysterically reported scientific studies which suggested (wrongly, it is now believed) that the vaccine might occasionally be hazardous. In many parts of the world, however, measles itself is a serious hazard. It kills about 200,000 children a year, and vaccination—using a liquid vaccine and a hypodermic—is the only way to prevent it.

Because measles attacks through the respiratory tract, though, Dr Sievers reckons this is a better place to send the vaccine than the muscles of the arm. And one way to do so would be to have the person being vaccinated inhale a finely powdered vaccine that coated every inch of his lungs. To make such a powder, Dr Sievers has perfected a trick that atomises liquid vaccine into tiny droplets. When the water evaporates, the particles of vaccine which remain are so small that they can spread through the lungs without clumping.

This is not as easy as it sounds. Atomisation nozzles are commonplace. They are used in everything from perfume bottles to car engines. But a nozzle alone is not enough. The droplets it produces—and hence the granules of the powder—are too big for Dr Sievers's purposes. Instead, he has turbocharged the process by mixing the vaccine with ultra-high-pressure carbon dioxide.

When this mixture emerges from the nozzle, it bubbles like champagne. The bubbles fragment, forming ultra-tiny drops, and when these dry they leave a powder with granules that are between one and five microns across. This powder can be doled out easily in individual doses and inhaled from a bladder—and a monkey that did so was protected from influenza. Human trials are expected to begin next year in India.

Skin fix

Mark Prausnitz of the Georgia Institute of Technology and his team have devised a different way to replace the hypodermic needle. They have successfully inoculated mice against flu using scores of tiny needles that might be referred to as "hyperdermic", because they do not fully penetrate the skin. This method, too, eliminates the need to transport liquid vaccine around.

Dr Prausnitz's vaccine-delivery device is a steel patch with an array of needles, each about half a millimetre long, on it. The array is coated with liquid vaccine mixed with a thickening agent. This dries, leaving the needles impregnated with solid vaccine. The resulting device is robust and reasonably insensitive to heat.

To use it, you press it against someone's skin (possibly your own). The needles painlessly puncture the skin, but do not go through it. Moisture from the body then dissolves the vaccine and it spreads into the skin in minutes.

That the patches are self-applicable is a huge bonus. Dr Prausnitz hopes it might be feasible to send vaccines to people by post during an epidemic, obviating the need for them to go to a clinic.

At the moment Dr Prausnitz's technique, like Dr Sievers's, has been tried only on animals, but it has such elegance and simplicity that if human trials are successful it could prove to be important in controlling influenza. Exactly who should receive influenza vaccine is the subject of this article.