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Vaccine delivery technologies of the future

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Respiratory syncytial virus (RSV), a disease that causes infections of the lower respiratory tract mostly in infants and children, claims lives of nearly 200,000 children every year. Nearly all of these deaths -99 percent - occur in low-income countries. In developed nations such as the US, nearly all children are get infected by RSV before their second birthday.

There are many such diseases that claims thousands of lives every year for the lack of vaccines to prevent them.

Global agencies such as PATH, World Health Organization, Bill & Melinda Gates Foundation, Research Council of Norway, the US Department of Health and Human Services and the UK Department for International Development are working closely to accelerate the development of vaccines for such diseases that will be effective and affordable in countries that most urgently need them.

But despite the innovations taking place in the field of vaccines, over 25 million new cases of HIV, Hepatitis B and Hepatitis C infections occur every year in the world because of needle reuse or contaminated devices. Disposal of used injection devices is also a challenge in providing vaccination in areas with limited resources. All these have led the researchers to also focus on new delivery technologies to address these needs. (Read Drug delivery: 11 technologies of the future)

Auto-disable one-time use syringes and pre-filled syringes hold significant promise. Both syringes get deactivated following the use, thereby preventing improper use. Since 2007, UNICEF has procured over 1.3 billion auto-disable syringes every year

for use in developing countries for immunization programs.

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Vaccine producers are also working to commercialize vaccines in Uniject devices, which are pre-filled syringes that combine vial, syringe and needle. They reduce vaccine wastage associated with multi-dose vials. The device has been used by UNICEF for tetanus elimination programs in countries such as Africa and Afghanistan.

Researchers are also exploring intradermal vaccine delivery as vaccines when administered directly under the skin may require lower doses. PATH is working with partners to refine an intradermal adapter for standard needles and evaluate micro-needle technologies. It is also exploring new vaccine formats for mucosal delivery (fast dissolving tablets) and sublingual delivery (thermoresponsive gels), which may enhance immunization effectiveness, safety and efficiency in low-resource settings.

In addition to the above, research is on to assess the effectiveness of delivering vaccines intradermally by using disposable syringe jet injectors (DSJIs) that can reduce the amount of vaccine required by up to 80 percent. These injectors generate a high pressure liquid stream that allows the vaccine to penetrate the skin without the need of a needle.

Bioject Medical Technologies, developer of needle-free injection therapy systems, has advanced the clinical research of intradermal delivery of vaccines in developing country immunization programs, in collaboration with PATH and WHO. Its Intradermal Pen is intended to improve the safety and ease of intradermal delivery of vaccines and enable immunization programs to stretch their supplies to benefit a larger number of beneficiaries.

Intranasal delivery is also an alternative. Multinational company AstraZeneca offers an intranasal vaccine FluMist, prescribed for age group of two to 50 years, for seasonal influenza in 2003. Serum Institute of India (SII) introduced India's first intranasal vaccine Nasovac against H1N1 virus in 2010. Similarly, Australia's Walter and Eliza Hall Institute and Royal Melbourne Hospital is conducting human trials for a nasal spray vaccine for type 1 diabetes.

There are many such institutions around the world that are working on developing new technologies for more effective vaccine delivery. Together with cutting-edge packaging technologies, they have the potential to revolutionalize immunization programs, especially in emerging countries where device disposals and logistics are issues.