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**ANN LINDSTRAND:** Hi. My name is Ann Lindstrand. I am a public health pediatrician and a lecturer in international health. Currently, I work as the head of the vaccine program at the Public Health Agency of Sweden.

Immunization, or vaccination, is one of the best public health interventions available to save the lives of children. Every year, immunization averts an estimated two to three million deaths from diseases like diphtheria, tetanus, whooping cough, and measles. Today I'll talk about the importance of high vaccination coverage, the importance of well-functioning routine vaccination services, and what it takes to reach the last child, the one furthest away. I will also mention some of the newest vaccines, the last ones to be rolled out worldwide.

Now let's start with the basics. Vaccines work. They save lives. Measles mortality worldwide has decreased by 75% in the last 15 years, mainly due to high vaccination coverage.

Currently, about 85% of all children get at least one dose of measles vaccine. Measles is a highly contagious disease caused by virus, resulting in high fever and rash, and can lead to brain infection and death, and many complications of bacterial infections. But with two doses of measles vaccine, there is a 99% protection. A very effective vaccine, indeed.

But as many as 95% of children in an area need to be vaccinated to stop outbreaks to occur. And therefore, last year at least 150,000 children were estimated to have died before the age of five years due to measles virus. This is a large number, but in the year 2000, it was more than half a million. So vaccines do work.

Look at the example of India, and the amazing effect in this vast country. And think about not in the lives saved, but also the health care resources saved that can now be used for other illnesses. India was declared polio-free in 2012, and in August 2015, declared free from maternal and neonatal tetanus, a major achievement in a country, partly due to very dedicated political leadership.

In the so-called old vaccines, in addition to the measles vaccine, there's also diphtheria, tetanus, whooping cough vaccine, as well as the polio vaccine. And in 2014, an estimated 85% of infants worldwide received three doses of this vaccine. This is really a major achievement, and far easier said than done.

Routine immunization is the backbone of a high coverage. All opportunities to vaccinate a child must be seized. That is, ideally, every time a child visits a health center, their vaccination status should be checked and vaccines should be given or scheduled if any one of them are lacking.

Despite improvements in global vaccine coverage during the last decade, there continues to be regional and local disparities, resulting in problems in this very complex system. It may be limited resources, competing health priorities, poor management of health systems, and inadequate monitoring and supervision.

In 2014, therefore, almost 20 million infants worldwide were not reached with routine immunization services. And more than 60% of these children live in 10 countries-- the Democratic Republic of Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan, Philippines, Uganda and South Africa.

Priority needs to be given to strengthen routine vaccination globally. And particularly, efforts are needed to reach the under-served, especially those in remote areas, in deprived urban settings, in fragile states, and war torn regions where most unvaccinated kids live. Here, outreach vaccinations, where healthcare workers move long distances and mop-up campaigns is needed. To reach the last child on the last mountaintop takes money and commitment, and quite some logistics.

It took all of the '80s and '90s to take the world from 17% to above 80% coverage all of the most important vaccines, the old vaccines. Now, in the last decade, several new vaccines have been developed. At the same time, the Global Alliance for Vaccine Initiative, GAVI, was established. And with the support and push of GAVI and UNICEF, introduction of new vaccines have been done at a tremendous speed.

The new vaccines include rotavirus vaccine and the pneumococcal vaccine. And both are very important to save lives of young children. Let's take a closer look at these vaccines.

Pneumococcal disease include invasive disease such as the pneumonia, meningitis and sepsis, but also non-invasive pneumonia, otitis media, and sinusitis. And pneumococcal disease, in all, causes more than 800,000 deaths per year in children under five. And the majority of those are due to pneumonia. Mortality is high, and risk of complications such as deafness after meningitis is high. Pneumococcal vaccine has been introduced in 117 countries

by the end of 2014, but the global coverage is estimated that 31%.

Many children worldwide die from some kind of diarrhoeal disease. The most common cause of severe cases of this disease is rotavirus. Nearly every child gets infected by the age of three to five years. When you have diarrhea, you basically secrete and lose liquid during a fast intestinal passage. As a result, you suffer from severe dehydration. And in fact, every year rotavirus kills an estimated 200,000 to 400,000 children under five years due to severe dehydration.

The current rotavirus vaccines are effective. Live attenuated vaccines, and given orally in two to three doses. The different rotavirus vaccines seem, though, to have a much better affect in high-income countries than in low-income countries. However, since most deaths occur in low-income countries, that is also where these vaccines will save the most lives. WHO recommended rotavirus vaccine to all over the world. And by mid-2015, rotavirus vaccines have been introduced in 77 countries, and global coverage is estimated to 19%, but it is rapidly increasing.

Human papilloma virus, the most common viral infection of the reproductive organ. It can cause cervical cancer, and other types of cancers and genital warts in both men and women. Human papilloma virus vaccines was introduced to 62 countries by the end of 2014. Since this is a vaccine that is meant to protect against cancer in the cervix, and it takes decades to develop this cancer type, we'll have to wait for the cancer rates to decline in order to show its real effectiveness. But so far, we've seen a very good effect on precancerous lesions, circulating HPV genotypes, and also genital warts.

When the global polio eradication initiative was launched in 1988, polio was endemic in 125 countries, and paralyzed about 1,000 children every day. Thanks to global efforts and vaccination, polio cases have fallen by 99%, from more than 350,000 cases a year to 414 reported cases in 2014, and much less in 2015. So today, more than 10 million people are walking who would otherwise have been paralyzed by the polio virus. With this few cases, a final eradication of polio is close, and only Afghanistan and Pakistan have so-called endemic spread.

Children's health worldwide has improved immensely due to these new vaccines. New thinking and new technology would improve vaccination coverage in the world. One of the challenges with vaccines is that they need to be stored in cool places. Keeping things cool in hot or rural

places can sometimes be difficult because of the energy, technology, and logistics you need to keep things cool.

Imagine vaccination without having to rely on a cold chain. No heavy cold boxes to carry, and without the logistics to carry ice blocks and maintain a steady low temperature. How much easier it would be to improve vaccine to those isolated rural areas. We have a good example.

The meningitis A vaccine was, from the beginning, developed by the Serum Institute of India, and was implemented in the meningitis belt in mid-Africa in 2012 and onwards, with a tremendous effect. And this vaccine was, from the beginning, as I said, licensed for use for more than three days in a temperature up to 40 degrees Celsius.

Many of the older vaccines could also be used outside of the cold chain. And the data exists that can prove that these vaccines are stable. But they're not licensed for that. And a mechanism to encourage pharmaceutical companies to re-license old vaccines out of the cold chain would result in many more children being reached.

Or imagine vaccination without need of a sterile needle. There are currently high research focus on immunization that can be dispatched on the skin, through micro-needles or injected using high pressure. Or vaccines that could be given in fewer doses. Now, a parent needs to bring a child for vaccination five times during the first two years of life, sometimes walking for many kilometers, and thinking about the other kids in the family, how to solve that.

2011 and 2020 has been announced as the Decade of Vaccine by WHO, and all countries of the World Health Assembly have signed the Global Vaccine Action Plan. This plan is very ambitious and takes real effort to implement-- everything from political commitment, to new technology, better price mechanism, and above all, dedicated health professionals, like yourself, to make this happen.