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Vaccine hope against a sexually transmitted disease: the answer to the burgeoning rise in a superbug

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Gonorrhoea is a common bacterial infection caused by a bacteria called Neisseria gonorrhoeae. It is usually sexually transmitted and can cause complications such as an infection of the upper part of the female reproductive system (i.e. pelvic inflammatory disease), septic arthritis and heart muscle inflammation. People can get gonorrhoea over and over again, sometimes several times in a single year: before the discovery of penicillin the disease was untreatable! However, over the years gonorrhoea has become resistant to antibiotics. Recently, strains have emerged that cannot be treated: in this way gonorrhoea has become a superbug.

Interest in a gonorrhoea vaccine extends back over one hundred years and the first vaccine was tested in humans in 1904. Since then just four vaccines have found their way into clinical trials and all failed to protect against the disease. With the absence of a vaccine and antibiotic resistance, the World Health Organization (WHO) indicated that gonorrhoea is a public health priority, and called for action in July 2017.

Until recently the likelihood of discovering an effective gonorrhoea vaccine was low. Many researchers are working on potential vaccine candidates: some of them look encouraging but several years will be necessary before their validation in clinical trials. However, there may have been some clues to potential vaccines staring us in the face for years.

The first clue appeared in Cuba several years ago. Researchers of the Finlay Institute in Havana reported a profound and sustained drop in meningococcal disease as well as gonorrhoea following the widespread use of a meningococcal vaccine, which was subsequently introduced into their infant vaccine schedule in 1991. Actually there was no concrete proof that the use of the meningococcal vaccine was responsible for such an effect also in gonorrhoea. But the bacteria that cause meningococcal disease and the one causing gonorrhoea are closely related. Both are members of the Neisseria family and they are 80-90% similar in their genes. This provides a biological evidence for the effect of meningococcal vaccine on gonorrhoea.

Most of the widely used meningococcal vaccines are conjugate vaccines. They are quite purified vaccines in the sense that they contain only selected sugar fragments of the bacterium that our immune system learns to recognize. However vaccines against the meningococcal group B have been made differently and until very recently only two of them have been widely used. These vaccines are based on vescicles produced by the bacterium, called outer membrane vesicles (OMV); moreover such vesicles contain many different proteins of great interest to our immune system.

Cuba was not the only country that used a meningococcal OMV vaccine widely. Between 2004 and 2008 New Zealand used a tailor made OMV vaccine called MeNZB to address a devastating epidemic of meningococcal disease. During a mass immunization campaign over one million people under the age of 20-years were vaccinated.

New Zealand was the only country that had the potential to look more closely at the possible effect of a meningococcal OMV vaccine on gonorrhoea cited before. By collecting all the cases of gonorrhoea and chlamydia (another sexually transmitted infection) from about half of the

clinics in New Zealand, our research was able to compare the meningococcal vaccine status between those people with gonorrhoea (cases) and chlamydia (controls). We found that a significantly smaller proportion of people diagnosed with gonorrhoea had been vaccinated compared with people diagnosed with chlamydia. This translated to an effectiveness of the meningococcal OMV vaccine against gnorrhoea of around 31%.

While this may not seem like a very effective vaccine, we must remember that this was not a gonorrhoea vaccine. More research is required to determine the possible effectiveness of other available OMV-containing vaccines such as the new meningococcal B vaccine Bexsero® as well as the Cuban vaccine. Also, investigating the mechanisms behind this effect will be important in order to be able to improve and develop new gonorrhoea-specific vaccines.

Of immediate relevance is that estimates indicate that even a vaccine with an effectiveness of thirty or forty percent, if used well, could reduce the incidence of gonorrhoea dramatically.