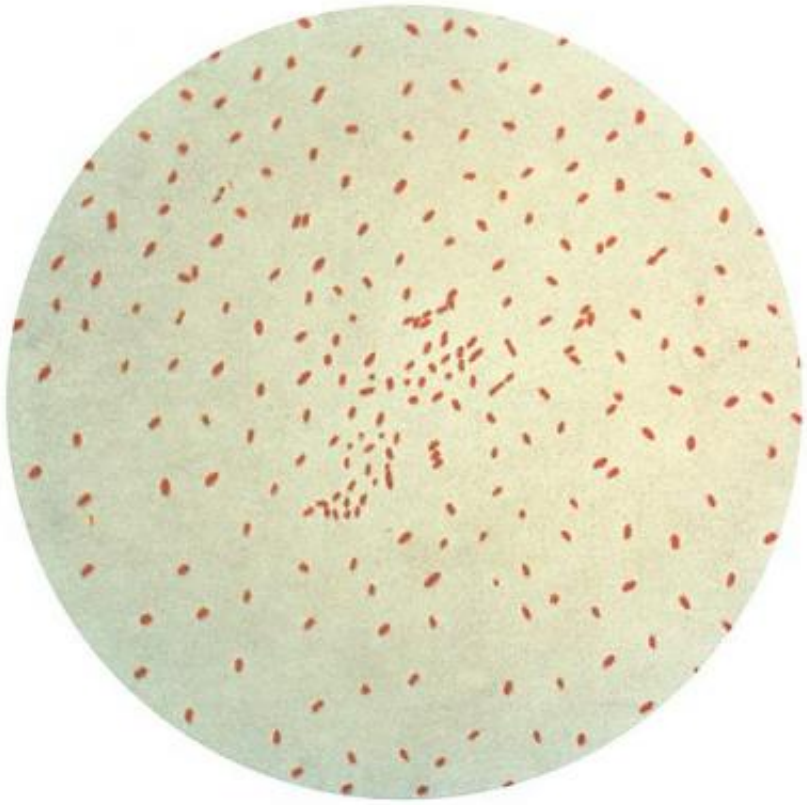
Whooping cough on the rise again

August 2 2013, by Lin Edwards



Gram stain of the bacteria Bordetella pertussis. Credit: CDC

(Medical Xpress)—Whooping cough (Pertussis) is a highly contagious disease caused by the bacterium *Bordetella pertussis* and characterized by attacks of severe coughing, often (but not always) with a characteristic

high-pitched "whoop" at the end. Until recently it appeared that the disease was close to being eradicated, but the incidence is now rapidly increasing.

The disease was first identified in France in the late 16th century, when it was known as the "dog bark" disease, and it can affect people of all ages but is especially serious and sometimes fatal in young children and the elderly. The coughing associated with the disease is usually worse at night and can last on and off for up to three months, and common complications include pneumonia.

The previous pertussis vaccine, DTP, was introduced in the 1940s and then phased out in the late 1990s because of its side effects, which included fevers and seizures. The side effects led to a rekindling of an anti-vaccine movement, and were eventually linked to endotoxin, a powerful immune system stimulant found in the membranes of the bacterial cells used in the vaccine.

At first the new vaccine, DTaP, seemed to have all the benefits of the old vaccine without the side effects, but over time it has become clear that the previous vaccine was more effective at preventing infection, and its replacement only reduces the risk of serious disease and death and the risk of spreading the disease, but it does not eliminate all risk of becoming infected.

According to a number of studies, this may be because the old vaccine contained whole killed bacterial cells along with detoxified tetanus and diphtheria particles, and hence thousands of components to stimulate the immune system, while the current vaccines are acellular versions containing fragments of pertussis with endotoxin removed, rather than whole cells, and it provides only one to four antigens to stimulate the immune system instead of the dozens in the old vaccine. Another reason for its failure to fully protect against the disease may be that there are

several strains of the bacteria, and they mutate over time, and some recent studies suggest recent strains lack a key component of the new vaccine, pertactin.

When, in 2010, 9,000 new cases of whooping cough were reported in California, and this was nine times the low of 1,000 in the entire country in 1976, scientists were faced with the reality that the DTaP vaccine did not provide protection for as long as the previous vaccine either. By 2012 the number of cases in the US had risen to 50,000 and increasing numbers of cases were also being seen in Europe, Australia, Japan, and other developed regions. It became clear that while the replacement of the old vaccine had reduced side effects, the costs had been great, with at least 18 infants dead in the US in 2012 and many more hospitalized.

One of the scientists involved in developing the new vaccine was vaccinologist Kathryn Edwards of the Vanderbilt University in Nashville, Tennessee, whose own daughter had suffered serious side effects from the old vaccine. She said that when the new vaccine was introduced patients given the new shot "made antibody responses that were comparable or even higher than the whole-cell vaccine." She also said that, "We were so excited that we had the answer, and now it isn't really the answer." One of the problems was that scientists did not fully understand how the pertussis vaccine works, but another is that the vaccine's effectiveness slowly wanes.

Studies have also shown that ironically, it may be endotoxin in the old vaccine that produced the more powerful immune response that gave the recipient long-standing protection, even though this component was identified as the trigger for the more severe side effects.

The present approach to these problems is to ensure the DTaP vaccine is being used as effectively as possible, by measures such as recommending pregnant women be given a booster to help protect against infection

passing to the baby through the placenta or via breast milk. There have also been proposals to give a second booster to adolescents.

Research is also being carried out around the world to either improve the current vaccine or to reintroduce a whole cell vaccine, either in a live cell form with some of the pertussis toxins deactivated or removed, or a killed cell form with the endotoxin genetically detoxified. The costs of developing new vaccines are great, but the costs of allowing the number of cases to continue to rise could well be greater.

More information: The Pertussis Paradox, Arthur Allen, *Science* 2 August 2013: Vol. 341 no. 6145 pp. 454-455 DOI: 10.1126/science.341.6145.454

Abstract
In recent years, there have been major outbreaks of pertussis, also known as whooping cough. Now, intensive studies are under way to investigate why acellular vaccines, dubbed DTaP, don't protect for as long as the original DTP vaccine.