



# A tale of two microbes

RUBELLA IS ON ITS WAY OUT, BUT PERTUSSIS REMAINS A SIGNIFICANT PUBLIC HEALTH CHALLENGE. TONY JAMES REPORTS ON PATHOLOGY'S ROLE IN CONTROLLING THESE INFECTIOUS DISEASES.

Two diseases, two vaccines, and two very different stories.

Vaccination against pertussis (whooping cough) and rubella (German measles) has been routine for many years, but there's little similarity in the recent history of these diseases.

While pertussis persists as a common respiratory disease in adults and continues to challenge the medical profession, rubella is close to being eliminated.

## Pertussis at large

Pertussis, caused by the bacterium *Bordetella pertussis*, is highly infectious. Between 70% and 100% of non-immune people living in the same household as an infected person are likely to develop the illness.

In babies and young children, it typically causes a persistent and distressing cough and can lead to severe complications including pneumonia, seizures and brain damage. The infection causes about 250,000 deaths a year in developing countries, but vaccination programs have made fatalities a rarity in developed countries, with Australian authorities usually recording only one or two deaths each year.

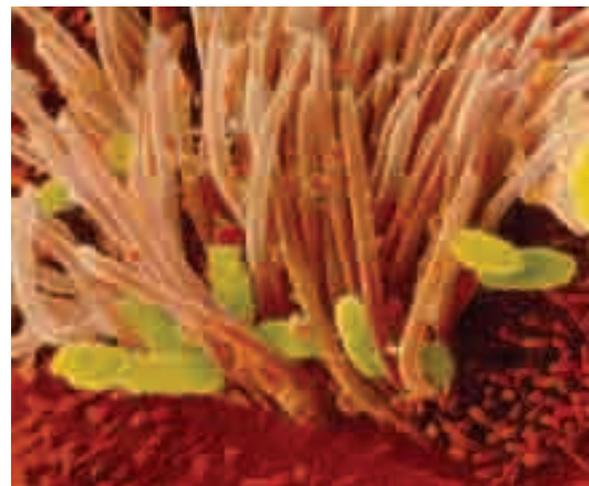
Pertussis causes much less severe disease in older children, adolescents and adults, who might have just a simple but

persistent cough. Some experience more serious disease, with complications such as pneumonia and problems from sustained, forceful coughing, ranging from urinary incontinence to inguinal hernia and pneumothorax. About 7000–10,000 cases a year are notified in Australia, with distinct epidemics occurring in addition to a stable background level of infection.

Although some immunity is provided from the mother at birth, this wanes quickly, so a first vaccination as soon as possible after two months is essential. Pertussis vaccination has long been included in routine childhood vaccination schedules, in combination with diphtheria and tetanus (DTP).

However, pertussis remains a public health challenge worldwide due to the continuing high rate of disruptive respiratory disease beyond childhood, the failure of vaccination to provide sustained protection, and a risk of complacency about routine childhood vaccination.

Despite widespread vaccination, pertussis has never been eliminated from any population. In fact, increased infection rates have been described in some developed countries, but the reason for this is far from certain. Better diagnosis might account for part of the rise, and incomplete protection from vaccination is



also a factor. In the first year after a primary course of three injections there is virtually 100% protection against fatal or severe disease, but only 90% protection against typical disease and 70% against mild disease. Immunity after vaccination has been estimated at 4–12 years, compared to up to 20 years after natural infection.

Adults are an important source of infection for vulnerable infants, so a number of countries have recommended boosters after childhood. The NHMRC suggests a booster can be given at any age from eight years onwards, and recommends that it be considered in adolescents aged 15 to 17, for both partners planning a pregnancy, for adults working with young children in healthcare or child care, and in any adult expressing an interest.

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PHOTO CREDIT: PAUL WRIGHT

**Above: Dr David Mitchell: "Much of the data on the epidemiology of pertussis is unreliable."  
Left: Scanning electron micrograph of Bordetella pertussis infection (green).**

### Pertussis in the path lab

Pathology tests for pertussis are designed to diagnose current infection or to confirm a recent infection. Dr David Mitchell, an infectious diseases physician and microbiologist at Sydney's Westmead Hospital, says the organism is fastidious and very difficult to culture in the laboratory.

"Growing the organism is the ideal way to make a diagnosis, and it also allows us to study the bacterium, its sensitivity to antibiotics and the way that it might be changing over time, but in most cases this is not an option," he says.

"Only a few specialised paediatric laboratories have the facilities for culture."

Polymerase chain reaction (PCR) tests for fragments of bacterial DNA, detectable

in very small samples, are now the method of choice for identifying pertussis during the first few weeks of infection.

Aspirating fluid from the nasopharynx is the optimal method of obtaining specimens, but the procedure is uncomfortable and disliked by adults, in whom throat swabs are usually adequate.

"PCR has limitations too," Dr Mitchell says. "For example, it detects dead organisms as well as living ones, so it can't be used to monitor the success of treatment."

Diagnosing a current infection has the greatest benefit where the patient might pose a threat to others, for example a staff member working in a neonatal intensive care unit, Dr Mitchell says.

Early treatment with erythromycin or other macrolide antibiotics can reduce the severity of symptoms and can help prevent infection of close contacts.

But decisions about excluding a staff member from work, monitoring others for infection, and possibly treating others to prevent infection can have serious implications and therefore require good evidence that the infection exists.

Serology – testing for antibodies to pertussis – can help confirm that the infection has occurred in people who have experienced typical symptoms, but is not particularly reliable.

"The tests available for routine laboratory use are neither sensitive nor specific for pertussis and can lead to over-diagnosis," Dr Mitchell says.

Rubella infections have continued to decline and now number fewer than 200 a year, compared to about 3000 annually in the early 1990s.

“This can be a problem when we are attempting to control an outbreak or restrict the spread of the disease in a workplace. It also means that much of the data on the epidemiology of pertussis is unreliable.”

### Careful interpretation

Like all pathology tests, the results of pertussis serology have to be interpreted carefully in light of the patient's illness. In a general practice environment, evidence that a patient has developed antibodies to pertussis after an episode of typical illness can provide some reassurance about the cause and likely course of the illness, and help rule out other causes of persistent cough.

Serology tests are not needed, and aren't helpful, in deciding whether an adolescent or adult should be revaccinated.

Greater success, however, has been achieved in controlling rubella.

This virus usually causes a self-limiting disease in adults. Inhalation typically leads to multiplication in the upper respiratory tract, then fever, a skin rash and spread of the virus to organs including the placenta of pregnant women.

In 1941 an Australian ophthalmologist, Norman Gregg, first made the link between rubella and birth defects.

He observed that some babies were born with congenital cataract – some also with congenital heart disease – after their mothers had rubella during pregnancy.

It's now known that maternal infection in the first 8–10 weeks of pregnancy is very likely to lead to foetal damage, with long-term consequences such as blindness, deafness, mental handicap and cardiac abnormalities.

Only 10–20% of babies are affected if the mother has rubella after 16 weeks' gestation.

Girls were first vaccinated against rubella in the 1960s, and immunisation – like natural infection – provides long-term protection. Rubella is now combined with measles and mumps vaccinations (MMR) in routine immunisations.

A national 'catch-up' campaign in 1998 aimed to ensure vaccination of all Australian adolescents, particularly the cohort of boys who had missed childhood immunisation. As a result, rubella infections have continued to decline and now number fewer than 200 a year, compared to about 3000 annually in the early 1990s. Only one or two cases of congenital rubella syndrome are reported in Australia annually.

### Role of rubella lab tests

The main aim of diagnosing current or recent rubella infection is to assist a pregnant woman to make an informed decision about the risk to her developing baby and whether the pregnancy should be terminated. Serological tests for antibodies are required in any pregnant woman who is thought to have rubella or who has been in contact with others who have the disease, regardless of their vaccination history.

A number of other rash-causing viral illnesses – including measles, parvovirus B19, human herpesvirus 6 and enterovirus – can closely resemble rubella and cannot be distinguished clinically, so laboratory confirmation is essential to make the diagnosis.

The presence of rubella-specific IgM strongly indicates current or recent infection, but the result must be interpreted by a specialist in light of

factors such as vaccination history, previous antenatal screening tests, and the date and duration of possible contact with other infected people. A sharp rise in IgG antibodies can also be detected within four to five days of symptom onset, but patients are rarely tested at this early stage. IgM levels remain elevated for 8–12 weeks after infection.

Specialised pathology tests can also be used to check for foetal infection if a woman wishes to continue with a pregnancy after contracting rubella. Tests include IgM levels in foetal blood sampled from the umbilical cord, or testing for viral genetic material in foetal blood or chorionic-villous samples.

The risk of rubella will continue for some years until there has been a sufficiently high uptake of MMR vaccination by children and adults of both sexes. The NHMRC recommends vaccination of non-pregnant women lacking antibodies, and female immigrants who have entered Australia after the age of routine vaccination – especially those from Asia, where natural infection rates and levels of immunity are low.

Screening for rubella antibodies is now a standard part of antenatal care. 📌

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**GPs NOTE: This article is available for patients at <http://pathway.rcpa.edu.au>**

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### Further reading

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