About the Immunisation Coalition

Our mission is to protect Australians against infectious diseases by advocating for immunisation.

We provide science based medical facts and create public awareness on the importance of immunisation.

IMMUNISATION COALITION

Pertussis (Whooping cough)

Date of review September 2020

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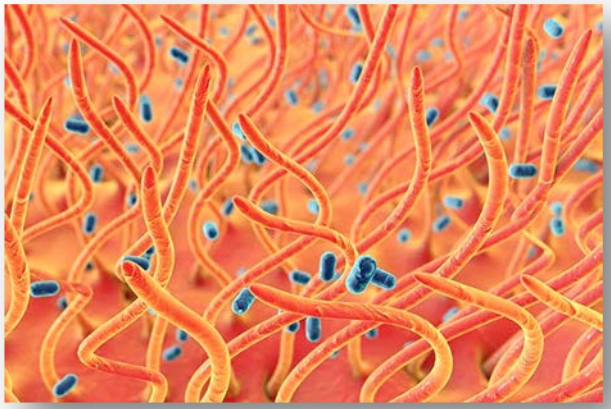
Bordetella pertussis and pertussis

- Pertussis is an acute **upper respiratory tract infection**, only found in **humans**
- The bacterium **Bordetella pertussis** causes pertussis
- These **bacteria attach** to the **cilia** (tiny, hair-like extensions) that line part of the upper respiratory tract
- The **bacteria release toxins** which damage the cilia and cause **airways** to **swell**



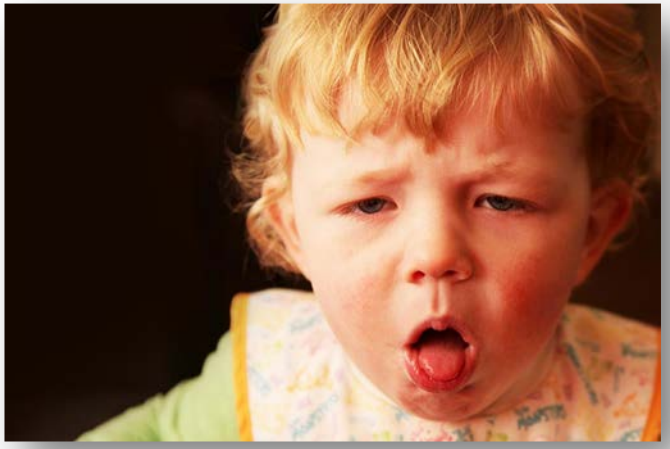
Bordetella pertussis

Ref: Centres for Disease Control and Prevention (CDC) Pertussis Causes and Transmission (last updated August 7, 2017) Accessed 9th September 2020

How is pertussis spread?

Bordetella pertussis is **highly contagious** and **spreads** from person to person through **contaminated respiratory droplets** (i.e. droplets containing the bacteria):

- when an infected person **coughs or sneezes**
- via direct contact with **secretions** from the **nose or throat**
- **droplets** can be **breathed in** by others or passed on by **touching** a **contaminated surface**
- people with pertussis are **infectious** for up to **21 days** after the onset of symptoms



Ref: Pertussis vaccines for Australians/ NCIRS Fact sheet: April 2019

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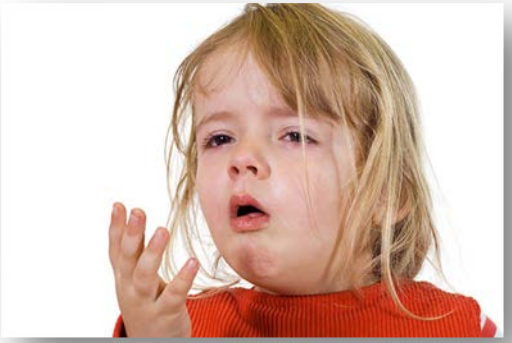
Symptoms of pertussis

- Begins with symptoms similar to a **cold**
- Develops into a **severe cough** that can last up to 3 months
- Cough followed by a **whooping sound on inhalation** (whoop may be absent in very young infants, older children and adults)
- **Apnoea** in young children
- **Vomiting** after severe coughing
- **Poor appetite, fatigue and dehydration**



Ref: Better Health Channel Whooping Cough (last updated October 2019) accessed September 2020.
Pertussis vaccines for Australians/ NCIRS Fact sheet: April 2019

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Possible progression of disease

Stage 1 Catarrhal Stage (1 – 2 weeks)

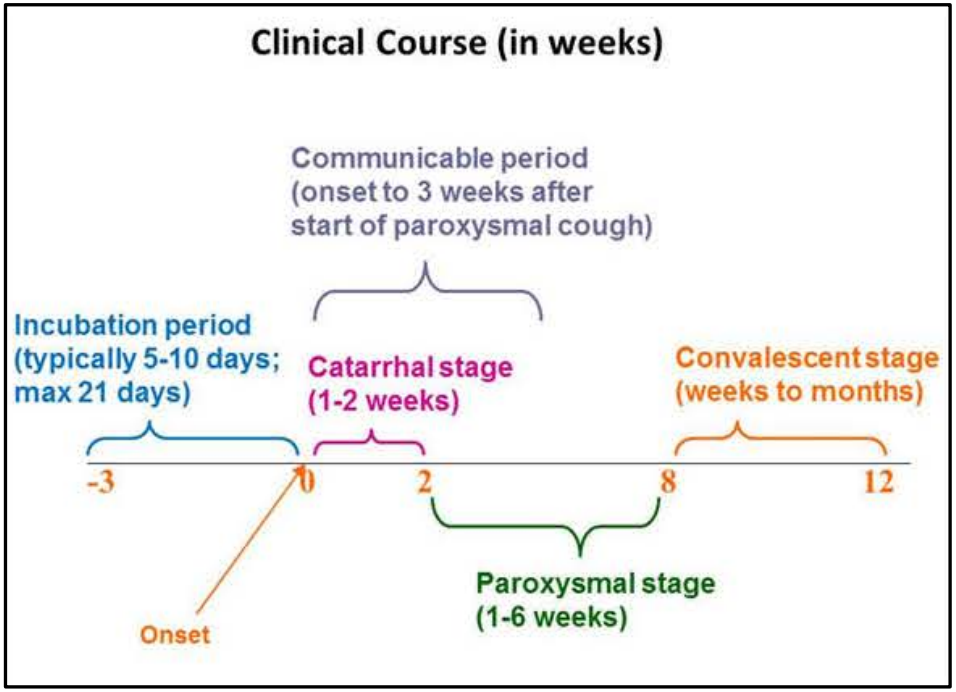
- runny nose
- Low-grade fever and
- Mild, occasional cough

Stage 2 Paroxysmal Stage (1 – 6 weeks)

- paroxysmal coughing (persistent coughing with sudden onset)
- whoop (inspiration sound after violent bout of coughing)
- cyanosis
- vomiting and exhaustion

Stage 3 Convalescent Stage (weeks to months)

- gradual recovery with less coughing



Ref: Centres for Disease Control and Prevention (CDC) Pertussis Clinicians Clinical Features (last updated October 2019) Accessed 9th September 2020

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What are the complications of pertussis?

Infants

50% of infants <12 months of age who contract pertussis will require hospital treatment and approximately:

- 68% will have apnoea
- 23% get pneumonia
- 1.2% will have seizures
- 1% will die
- 0.4% will have encephalopathy (as a result of hypoxia from coughing or possibly from toxin)

Adolescents and adults

- Encephalopathy as a result of hypoxia from coughing or possibly from toxin
- Pneumothorax
- Rectal prolapse
- Subdural hematomas
- Seizures

Ref: Centres for Disease Control and Prevention (CDC) Pertussis Clinicians Clinical Features (last updated October 2019) Accessed 9th September 2020

Poll 1

What is the most common cause of death in babies with pertussis?

A. Acute myocardial infarction due increased plasma viscosity caused by Bordetella pertussis

B. Pertussis pneumonia sometimes complicated by seizures and hypoxic encephalopathy

C. Diabetic coma as Bordetella pertussis can cause increase in blood sugar

D. Kidney failure

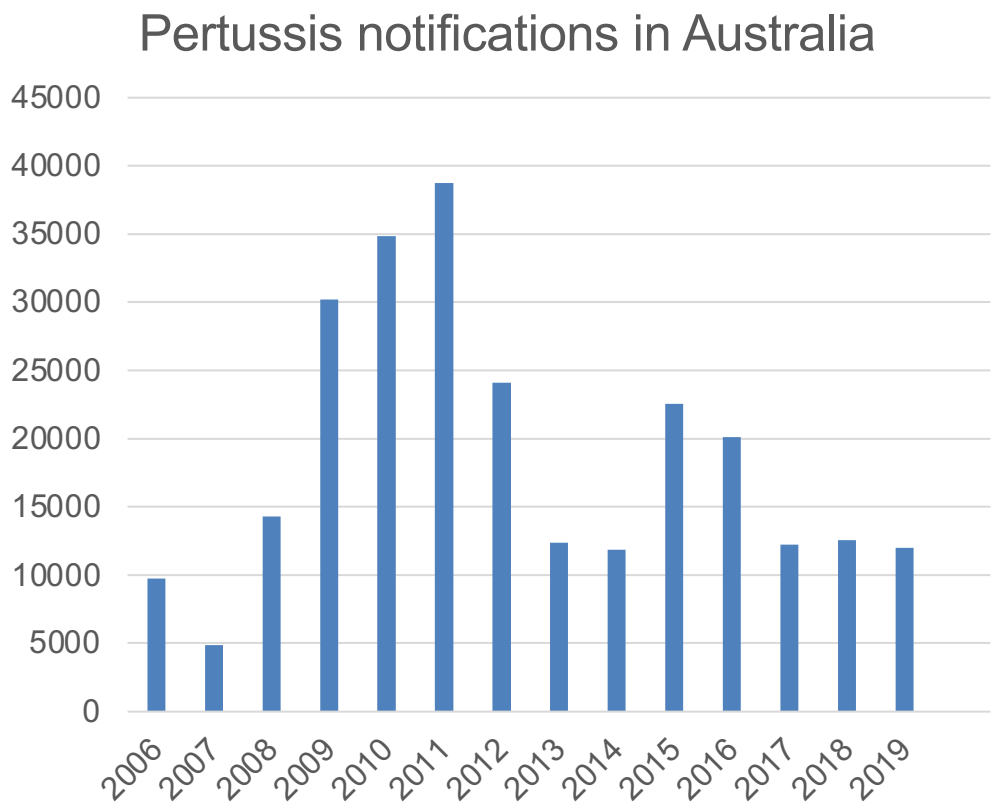
Ref:. Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au

Burden of disease

Between 2008 and 2012, **largest** Australian **epidemic** since 1991

- **Highest** rates of **disease** were in **children < 6 months** of age and **children 5-9 years** of age

Since 2006, the **highest** annual incidence of **pertussis** was in **2011**



Ref: Department of Health, National Notifiable Diseases Surveillance System
Pertussis vaccines for Australians/ NCIRS Fact sheet: April 2019.

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Burden of disease

Some suggested reasons for high notification rates during 2008-2011 epidemic:

- **more accessible** and **sensitive diagnosis** with nucleic acid testing
- **waning of DTPa** vaccine-induced immunity

Year	Pertussis Notifications
2008	14294
2009	30186
2010	34836
2011	38755

Ref: Department of Health, National Notifiable Diseases Surveillance System, Accessed 9th September 2020. Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

Burden of disease

In **2019**:

- **12025** cases of pertussis were reported to the National Notifiable Diseases Surveillance System (NNDSS)
- Notification rate of **47.4 cases per 100,000** population
- **53%** of pertussis notifications were in **children under 15 years** of age

Ref : Department of Health, National Notifiable Diseases Surveillance System, Accessed 8th September 2020

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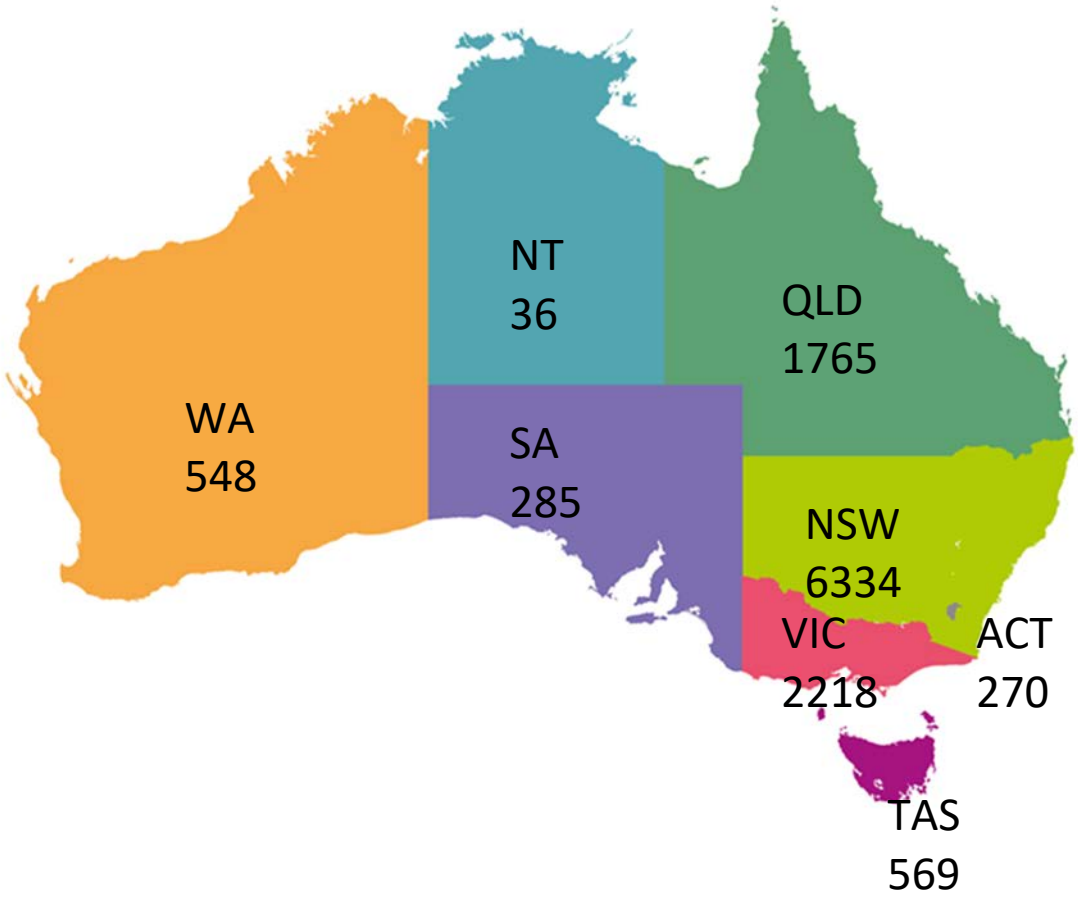
Cases of pertussis in Australia

Notifications of pertussis reported in 2019, varied across states
Total = 12025



Ref: Department of Health, National Notifiable Diseases Surveillance System, Accessed 8th September 2020

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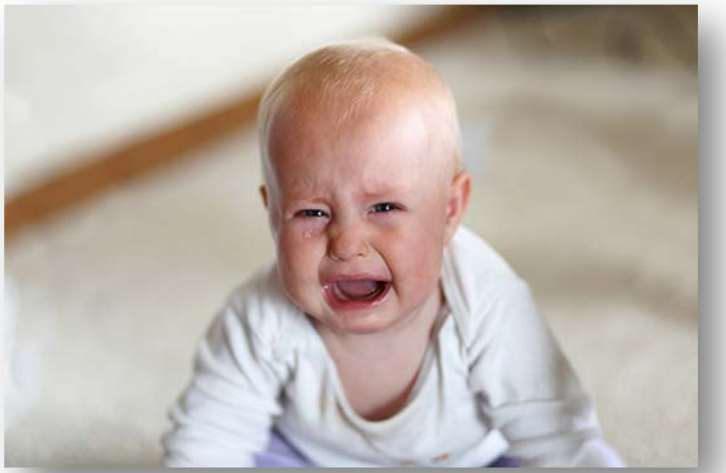
Who is most at risk?

Pertussis can affect **people of any age** including:

- **Babies and young children** are at greatest **high risk** of **severe disease and death**

- **Older children and adults** may have atypical, less serious disease however cough may continue for many weeks regardless of treatment and cause:
  - sleep disturbance
  - sore ribs (rib fracture is possible but rare)
  - nose bleeds
  - hernia
  - time off work/study



Ref: NHS choices. Whooping cough-Complications http://www.nhs.uk/Conditions/Whooping-cough/Pages/Introduction.aspx (Accessed 9 September 2020). Australian Technical Advisory Group on Immunisation (ATAGI). *The Australian immunisation Handbook 10th* ed (2017 update). Canberra: Australian Government Department of Health, 2017.

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Infants less than 6 months are at greatest risk of severe illness and death

- Children **under one year** of age have a **50% hospitalization rate**
- **Mortality** in hospitalised infants less than 6 months of age is **3.5% compared to 0.03%** in the general population
- If a **child under 6 months** of age gets whooping cough, they will **usually need to be admitted to hospital**
- Between 2006 and 2012 **ten of the eleven** pertussis **deaths** were in **unvaccinated infants <2 months**

Ref:: Better Health Channel Whooping Cough (last updated October 2019) accessed September 2020. Royal Children's
RACGP Pertussis - Presentation, investigation and management accessed September 2020
Australian vaccine preventable disease epidemiological review series: pertussis, 2006–2012 Accessed September 2020
Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018,
immunisationhandbook.health.gov.au.

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Who should be vaccinated?

Children and Adolescents

- Pertussis vaccine on National Immunisation Program (NIP) for children **2, 4, 6, 18 months** and **4 years** of age
- An **adolescent booster** is available through **school** immunisation programs at **12-17 years**
- **Free catch up** vaccines for **10-19-year olds**

Ref::Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

Australian Government Department of Health National Immunisation Program: Free Catch up Vaccines for all individuals 10-19 years of age Fact Sheet

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National Immunisation Program

Vaccine	2 m*	4 m	6 m	18 m	4 y	12-<13 yrs
(DTPa)#	1st dose	2nd dose	3rd dose	1st booster	2nd booster	
(dTpa)+						3rd booster

*First dose can be given as early as 6 weeks of age

DTPa= Diphtheria tetanus and acellular pertussis-containing vaccines, which are used in children <10 years of age. There are six formulations funded on the NIP: Infanrix (DTPa), Infanrix hexa (DTPa-hepB-IPV-Hib), Infanrix IPV (DTPa-IPV), Quadracel (DTPa-IPV) and Tripacel (DTPa)

+ dTpa signifies formulations that contain substantially lesser amounts of diphtheria toxoid and pertussis antigens than child (DTPa-containing) formulations. dTpa vaccines are usually used in adolescents and adults. There are four formulations: Boostrix (dTpa), Boostrix-IPV (dTpa-IPV), Adacel (dTpa) and Adacel Polio (dTpa-IPV). NIP funded vaccine is Boostrix and Adacel.

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au

Who should be vaccinated?

Adults

- dTpa vaccine is recommended for **any adult** who wishes to **reduce** the **likelihood** of becoming ill with **pertussis:**
  - particularly **important** for adults who meet the criteria of a **special risk group**
  - **free catch up** vaccines available for **refugees** and **humanitarian entrants** aged **20 years and older**

Ref::. Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.
Australian Government Department of Health National Immunisation Program: Free Catch up Vaccines for refugee and humanitarian entrants aged 20 years and over Fact sheet

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Special Risk Groups

Pregnant women

- dTpa is recommended during the **mid second trimester to early third trimester** of each **pregnancy**
- **Available on the NIP**
- **Optimal time**: between **20** and **32** weeks
- Can be given at any time up until delivery

Benefits

- **protects the newborn** especially in the **first 6 weeks** of life:
  - via **antibodies** that **cross** the **placenta**

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

Poll 2

When are maternal antibodies likely to be transported to the foetus:

A. From 2 weeks onwards with a maximum transfer 20 weeks gestation onwards

B. From 20 weeks onwards

C. From 13 weeks onwards with a maximum transfer 30 weeks gestation onwards

D. From 30 weeks onwards

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

Special Risk Groups

Before hospital discharge

- Women who have not received dTpa during pregnancy:
  - should be vaccinated as soon as possible after delivery

Benefits

- reduce likelihood of pertussis occurring in the mother
  - provide some indirect protection to the infant

Ref:: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

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Special Risk Groups

Evidence from studies of infant pertussis cases indicates that:

- **household contacts** and carers are frequently the **source** of infection
- with **parents** identified as the source for **more than 50% of cases**

Ref: Wiley KE, Zuo Y, Macartney KK, McIntyre PB. Sources of pertussis infection in young infants: a review of key evidence informing targeting of the cocoon strategy. *Vaccine* 2013;31:618-25.

Special Risk Groups

People in contact with infants

Adult **house contacts and carers** (e.g. fathers and grandparents) **of infants < 6 months** of age should receive

- dTpa **at least two weeks before** beginning close contact with infant

- a booster of dTpa if have not received one in previous 10 years

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

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Special Risk Groups

Adults working with young children <4 years of age

and

All healthcare workers should receive a

- dose of dTpa vaccine
- a booster dose every 10 years

Ref: Australian Technical Advisory Group on Immunisation (ATAGI). *The Australian immunisation Handbook 10th* ed (2017 update). Canberra: Australian Government Department of Health, 2017.

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Vaccine Formulations

DTPa-Diphtheria tetanus and acellular pertussis-containing vaccines, which are used in children < 10 years of age

Trade Name	Formulation
Infanrix	DTPa
Infanrix hexa	DTPa-hepB-IPV-Hib
Hexaxim	DTPa-hepB-IPV-Hib
Infanrix IPV	DTPa-IPV
Quadracel	DTPa-IPV
Tripacel	DTPa

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au

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Poll 3

Infanrix hexa must be reconstituted by adding entire contents of syringe to the vial and shaking until pellet is entirely dissolved. Reconstituted vaccine should be used as soon as practicable, however, the reconstituted vaccine may be stored:

A. In the fridge for not more than 24 hours

A. At room temperature for not more than 24 hours

B. In the fridge for not more than 8 hours

C. At room temperature for not more than 8 hours

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au

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Vaccine Formulations

dTpa formulations that contain substantially **lesser amounts** of **diphtheria** toxoid and **pertussis** antigens than child (DTPa-containing) formulations.

dTpa vaccines are used in **adolescents and adults**.

Trade Name	Formulation
Boostrix	dTpa
Boostrix-IPV	dTpa-IPV
Adacel	dTpa
Adacel Polio	dTpa-IPV

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au

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Vaccine efficacy

A 3-dose primary series of immunisation with DTPa vaccine at 2, 4 and 6 months of age results in:

- **84% protective efficacy** against severe disease

Ref: Zhang L, Prietsch SO, Axelsson I, Halperin SA. Acellular vaccines for preventing whooping cough in children. Cochrane Database of Systematic Reviews 2012;(3):CD001478.

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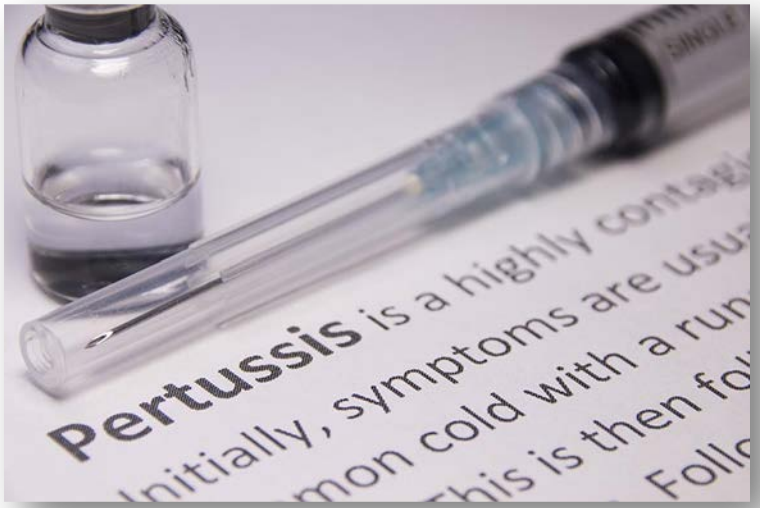
Vaccine efficacy

- Immunity to pertussis wanes over time
- Effectiveness of three doses **declined** progressively from **2 years** of age to **less than 50% by 4 years** of age



Ref: Quinn HE, Snelling TL, Macartney KK, McIntyre PB. Duration of protection after first dose of acellular pertussis vaccine infants. Pediatrics 2014;133:e513-9.

Vaccine efficacy

- A large trial in **adolescents and adults** demonstrated overall vaccine efficacy against confirmed pertussis of **92% within 2.5 years of vaccination**

Ref: Ward JI, Cherry JD, Chang SJ, et al. Efficacy of an acellular pertussis vaccine among adolescents and adults. New England Journal of Medicine 2005;353:1555-63.

Vaccinating pregnant women
Is there evidence to support this?

Vaccinating pregnant mothers in UK
at least 7 days before delivery:

- **Reduced pertussis** disease **by 91%**
  in **infants <3 months** of age

Ref: Amirthalingam G, Andrews N, Campbell H, et al. Effectiveness of maternal pertussis vaccination in England: an observational study. The Lancet 2014;384:1521-8. 16

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Cocoon Vaccination
Is there evidence to support?

Emerging data on the **effectiveness** of indirect **protection to infants** from the **cocoon approach** suggest:

- modest benefit

- **50% reduction in pertussis** disease in young infants **when both parents were vaccinated at least 4 weeks before disease onset** in the infant

Ref: Quinn HE, Snelling TL, Habig A, et al. Parental Tdap boosters and infant pertussis: a case-control study. *Pediatrics* 2014;134:713-20.. Australian Technical Advisory Group on Immunisation (ATAGI). *The Australian immunisation Handbook* ed (2017 update). Canberra: Australian Government Department of Health, 2017.

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Vaccine Safety

Compared to whole-cell pertussis vaccines (DTPw), **acellular pertussis vaccines** are associated with a much **lower** incidence of:

- **Fever** (20% vs 45%)
- **Local reactions** (10% vs 40%)

Extensive **limb swelling** can occur with **booster doses of DTPa**.

Such reactions commence within 48 hours of vaccination,

- last 1-7 days and
- **resolve completely**

Limb swelling

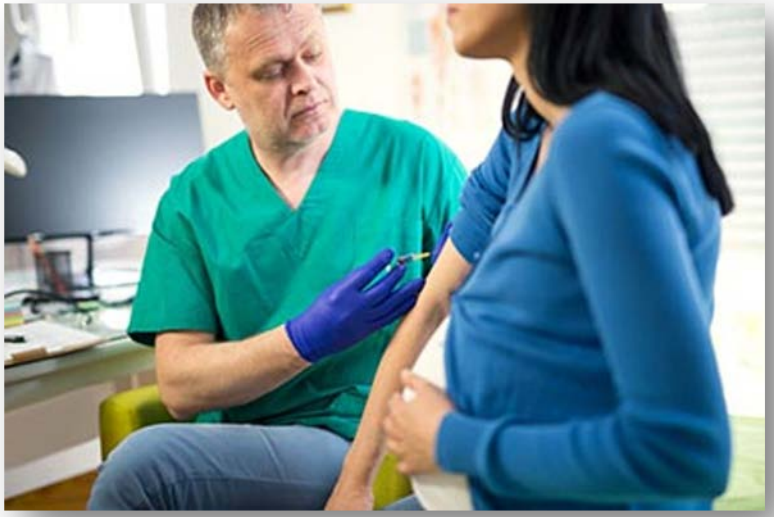
Ref: Australian Technical Advisory Group on Immunisation (ATAGI). *The Australian immunisation Handbook 10th* ed (2017 update). Canberra: Australian Government Department of Health, 2017.

Vaccine Safety

Pregnancy

Studies show:

- **no increased risk of pregnancy outcomes** such as stillbirth, pre-eclampsia, foetal distress, low birth weight or neonatal renal failure related to pertussis vaccination during pregnancy



Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

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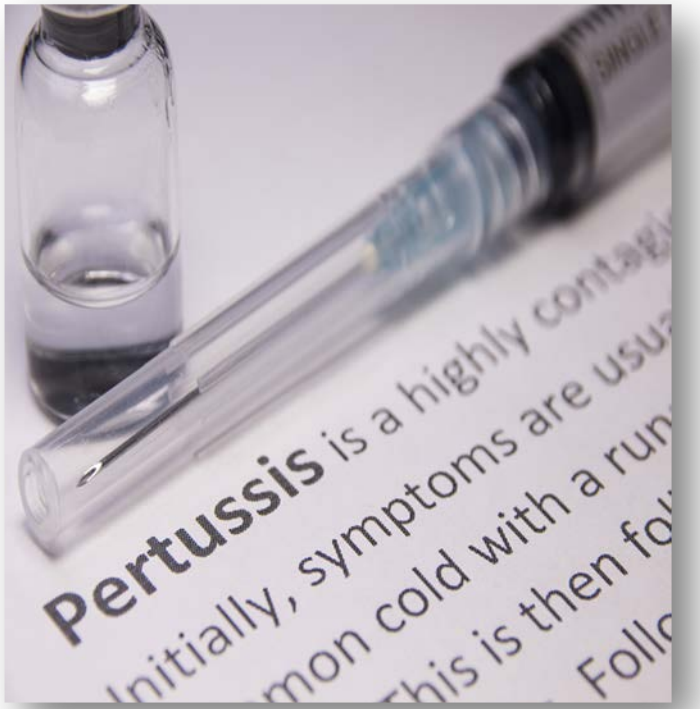
Vaccine contraindications

The only absolute contraindications to acellular pertussis-containing vaccines are:

- **anaphylaxis** following a previous dose of any acellular pertussis-containing vaccine

- anaphylaxis following any vaccine component



Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.

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Treatment to prevent disease transmission

Pertussis is treated with:

- usually **azithromycin** for **5 days** or
- **clarithromycin** for **7 days** or
- **trimethoprim+sulfamethoxazole** for 7 days

What do antibiotics do?

- **prevent the spread** of pertussis to other people
- effectively **eliminate B. pertussis**, the evidence that they alter the course of the disease is not conclusive

If **coughing longe**r than **three weeks**:

- rarely infectious
- **antibiotics not needed**

Ref: Therapeutic Guidelines Ltd (eTG June 2019 edition)

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Prophylaxis of pertussis contacts

Recommend **antibiotic prophylaxis** for:

- children **< 6 months** in contact with pertussis cases or
- **people** who may **transmit** pertussis **to** these **infants**
- **women** in **last month of pregnancy**

Use same antibiotic regimen as for treatment to prevent disease transmission

Ref: Therapeutic Guidelines Ltd (eTG June 2019 edition)

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Conclusions

- Pertussis is a **very contagious** respiratory infection caused by Bordetella pertussis
- The major symptom of pertussis is the characteristic **cough**, which is often followed by a **whooping** sound on inhalation
- **Infants less than 6 months** of age are at greatest risk of **severe illness and death**
- Free pertussis vaccination is available under NIP for children **2, 4, 6** and **18 months** and **4 years of age**. A booster is also available through the schools for **adolescents** (12-17 years of age)
- To reduce pertussis in infants, vaccination is recommended for their **close contacts, healthcare workers** and **pregnant women**
- Pertussis vaccine now available on **NIP** for **pregnant women (Optimal vaccination timing: 20-32 weeks gestation)**

Ref: Australian Immunisation Handbook, Australian Government Department of Health, Canberra 2018, immunisationhandbook.health.gov.au.