Epidemiology of Pertussis (Whooping Cough)

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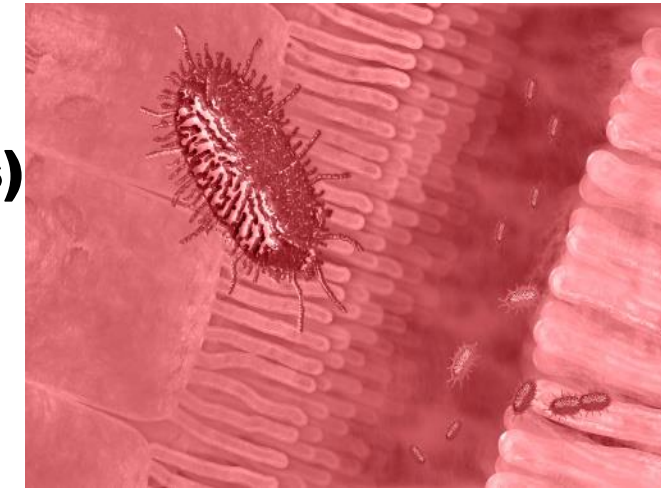
The disease first appeared in France in 1414. The first epidemic was described in 1578 by Guillaume de Baillou

The disease is endemic worldwide and continues to be a public health concern despite established pertussis immunization programs with high coverage.

Pertussis is acute highly infectious disease of children.

Causative Organism



Bordetella Pertussis (Pertussis bacillus)

The organism was first isolated by Jules Bordet and Octave Gengou in 1906.

Reservoir of Infection

Man, cases whether typical, or mild not showing the paroxysms, [No Carriers].

The organisms find exit in respiratory discharges.

Modes of Transmission

1. **Direct droplet infection; direct case – contact infection is the main mode of spread.**

2. **Air borne infection, with in short distance of the case.**

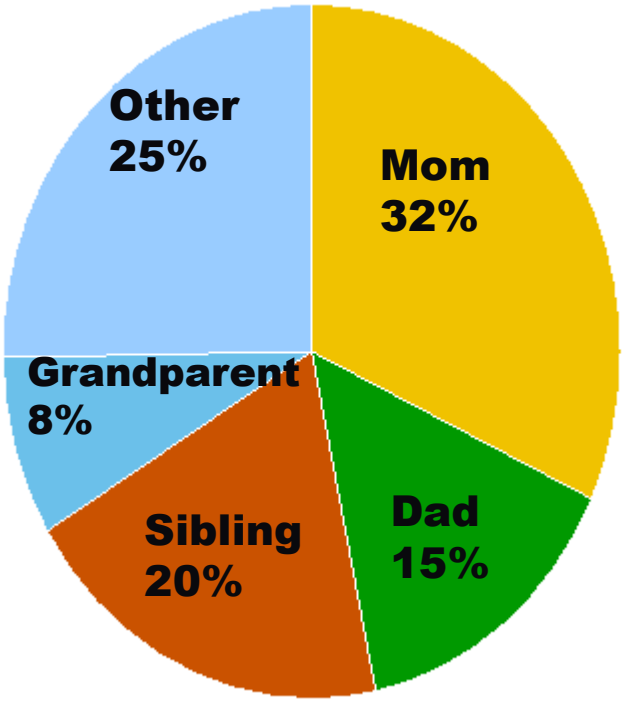
3. **Using soiled articles & fomites.**

In vaccinated populations, bacteria are frequently brought home by an older sibling.

When the source of whooping cough was identified, mothers were responsible for 30-40% of infant infections.

75% Of Suspected Sources For Infant Pertussis Cases Were Family Members

20% Other Adults



47% Mom or Dad

33% Other Children

Incubation period

Average 9-10days (range 6-20days)

Clinical Picture

Pertussis is a local disease of respiratory tract.

- **In apparent [atypical] Cases: do not show the typical paroxysms, and so are difficult to diagnose clinically, they are met with partly immune children & young adults.**

  - **Typical untreated Cases: they pass through the following stages:**

CLINICAL COURSE

- **Catarrhal stage: 1-2 weeks, insidious onset, with slight or no fever; upper respiratory catarrh; rhinitis, sneezing, dry irritating cough & lacrimation.**

- **This is the stage of maximum infectivity**

- **Paroxysmlstage:2-4 weeks, paroxysmal attacks of spasmodic coughing.**

- **Can be more frequent at night**

- **Each attack followed by characteristic whoop with expectoration of tenacious clear mucus & vomiting.**

- **The cough paroxysm consists of a short series of expiratory bursts, followed by an inspiratory gasp, which results in the typical "whoop".**

Maximum complications occur in this stage.

- **Convalescence:** 1-6 weeks, begins when whooping & vomiting stop, though coughing may persist for some weeks there after.

Treated Cases Chemotherapy eliminates infection and the case progressively improves in short time.

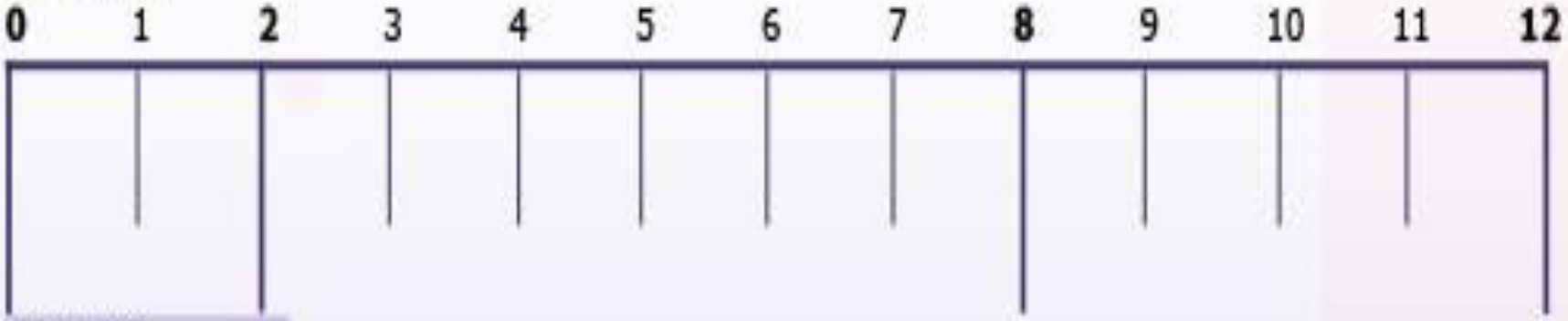
Infectivity

- **Untreated Cases:** **from onset of disease, and for 3 weeks after onset of characteristic paroxysmal coughing, infectivity is highest during the early catarrhal stage.**

- **Treated Cases:** **specific antibiotics therapy eliminates infection in about 7 days after starting treatment.**

Disease Progression:

Weeks



Stage 1 Catarrhal Stage

May last 1 to 2 weeks

- Symptoms: runny nose, low-grade fever, mild, occasional cough – Highly contagious

Stage 2 - Paroxysmal Stage

Lasts from 1-6 weeks; may extend to 10 weeks

Symptoms: fits of numerous, rapid coughs followed by "whoop" sound; vomiting and exhaustion after coughing fits (called paroxymsms)

Stage 3 - Convalescent Stage

Lasts about 2-3 weeks; susceptible to other respiratory infections for many

Recovery is gradual. Coughing lessens but fits of coughing may return.

Period Of Communicability Of Pertussis

- **Whooping cough is highly infectious, spreading to 70 to 100% of susceptible household contacts and 50 to 80% of susceptible school contacts.**

- **Persons with pertussis are most infectious during the catarrhal period and the first 2 weeks after cough onset (i.e., approximately 21 days).**

Complications

Major complications of pertussis in infants and children are of 3 types:

- **Pulmonary**
- **Neurologic (acute pertussis encephalopathy)**
- **Nutritional**

In develop settings, complications of pertussis such as bronchopneumonia occur in about 6% of infected children; infants aged.

In infants —complications from whooping cough are more severe and may include:

- ✓ **Pneumonia**
- ✓ **Slowed or stopped breathing**
- ✓ **Dehydration or weight loss due to feeding difficulties**
- ✓ **Seizures**
- ✓ **Brain damage**

Because infants and toddlers are at greatest risk of complications from whooping cough, they're more likely to need treatment in a hospital. Complications can be life-threatening for infants younger than 6 months old.

Possible complications of pertussis in older children and adults

Complications in older children and adults are usually much less serious that those in infants and young children.

May include:

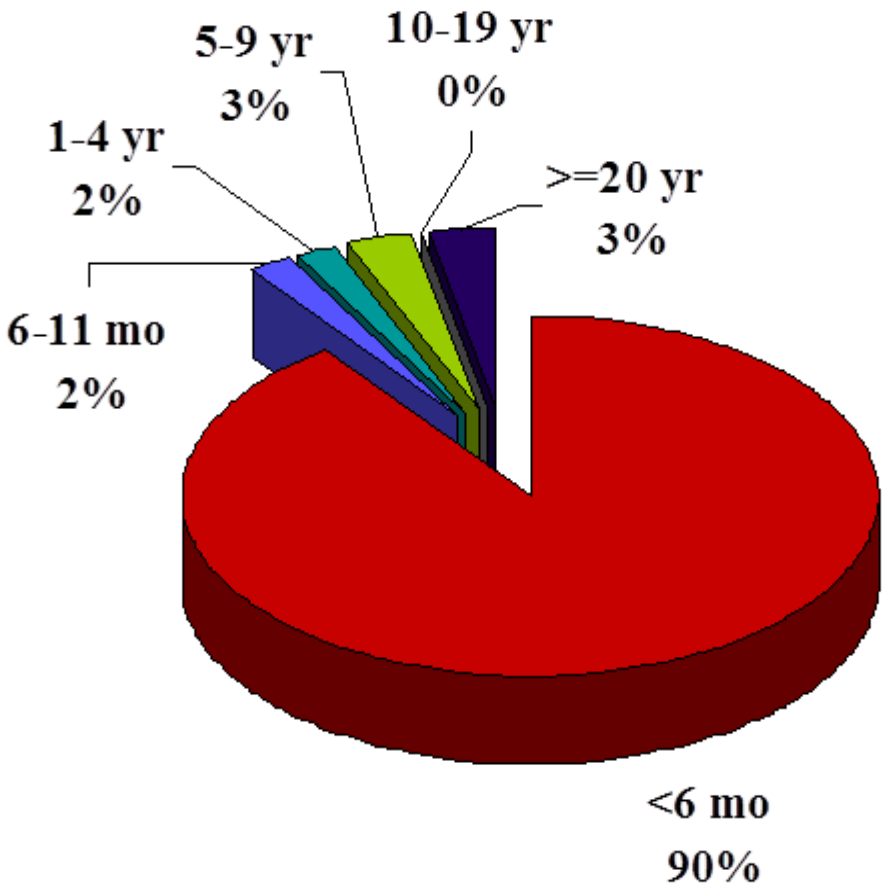
- **Nose bleeds and burst blood vessels in the white of the eye from intense bouts of coughing**
- **Bruised ribs as a result of intense coughing**
- **Hernia due to intense coughing**
- **A swollen face**
- **Ulcers on the tongue and mouth**
- **Ear infections such as otitis media**

Whooping cough kills about 250,000 children worldwide every year and many surviving children are left with brain damage.

Severe unmanaged cases, especially in infants & young children, are exposed to high case fatality, caused mainly by bronchopneumonia, enteritis, and cerebral complications, the majority of deaths reported below three years of age.

Pertussis Mortality

- **Death from pertussis occurs rarely but young infants <6 months of age are most at risk**
- **Risk factors for mortality**
  - **Female sex**
  - **BW <2500 grams**
  - **Apgar score <8**
  - **Mother with <12 years of education**



APGAR SCORING SYSTEM

	0 Points	1 Point	2 Points	Points totaled
Activity (muscle tone)	Absent	Arms and legs flexed	Active movement	
Pulse	Absent	Below 100 bpm	Over 100 bpm	
Grimace (reflex irritability)	Flaccid	Some flexion of Extremities	Active motion (sneeze, cough, pull away)	
Appearance (skin color)	Blue, pale	Body pink, Extremities blue	Completely pink	
Respiration	Absent	Slow, irregular	Vigorous cry	

Severely depressed	0-3
Moderately depressed	4-6
Excellent condition	7-10

In developed countries , lethality of pertussis is very low (<1/ 1000)

In developing countries, the average CFR for pertussis has been estimated at almost 4% in infants and at 1% in children aged 1–4 years.

Diagnosis

- **Clinical:** based on finding the typical paroxysmal attacks of coughing, ending in high pitched inspiratory whoop.

Laboratory:

Diagnosis of pertussis should only be attempted in patients with symptoms compatible with pertussis, such as prolonged coughing with paroxysms and/or whooping or choking.

In infants, older vaccinated children, adolescents and adults the clinical course may not be typical, and prolonged coughing may be the only symptom.

In these cases, diagnosis of pertussis requires laboratory methods for confirmation

The organism is demanding, surviving only a few hours in respiratory secretions and thus requiring special media for culture.

Diagnosis is most accurately made by PCR (polymerase chain reaction) testing in a pathology laboratory of mucus from the nose and throat, combined with clinical history, although blood tests are still used in some places.

Susceptibility

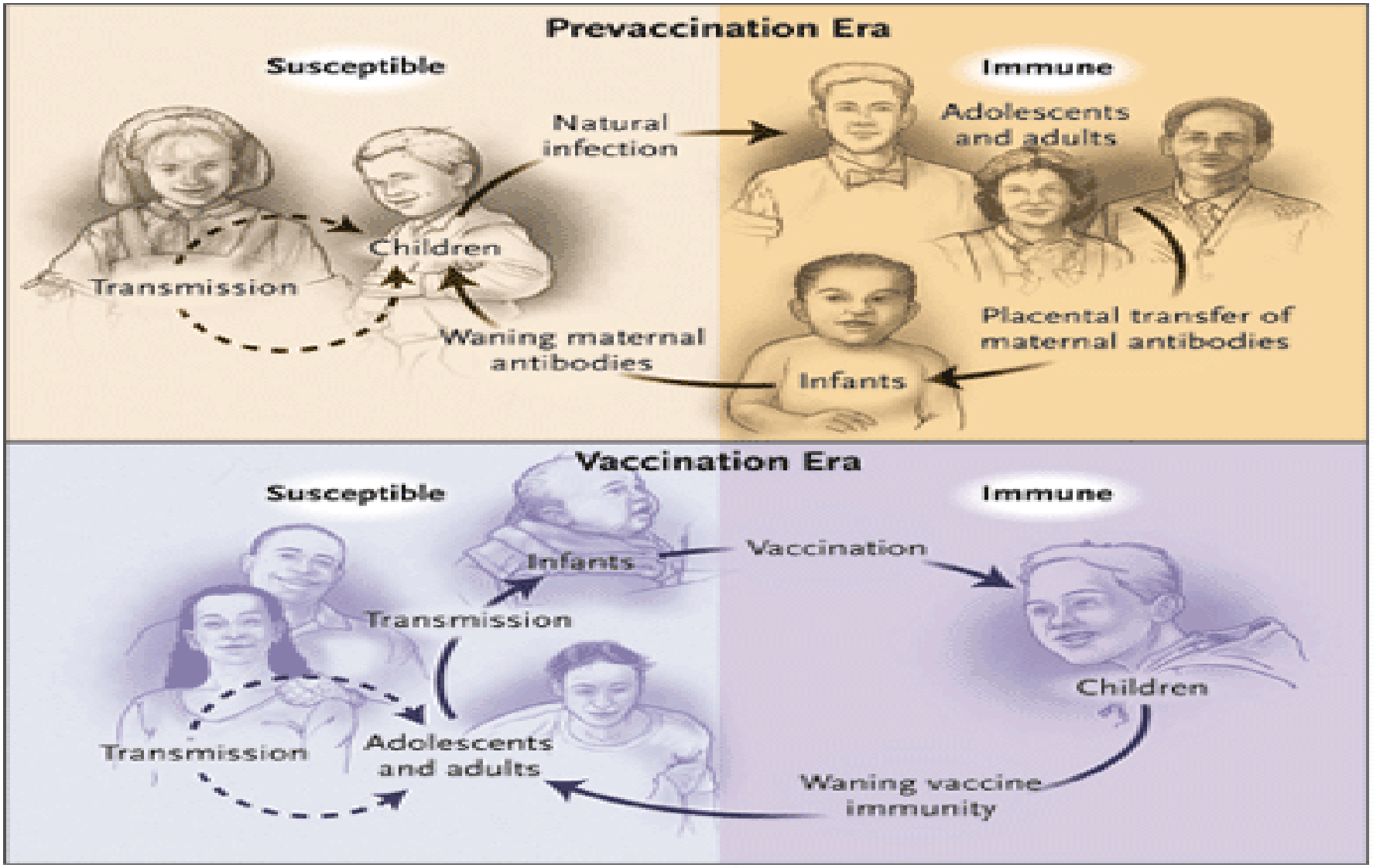
1. **Begins at birth, no maternally acquired immunity ??WHY**

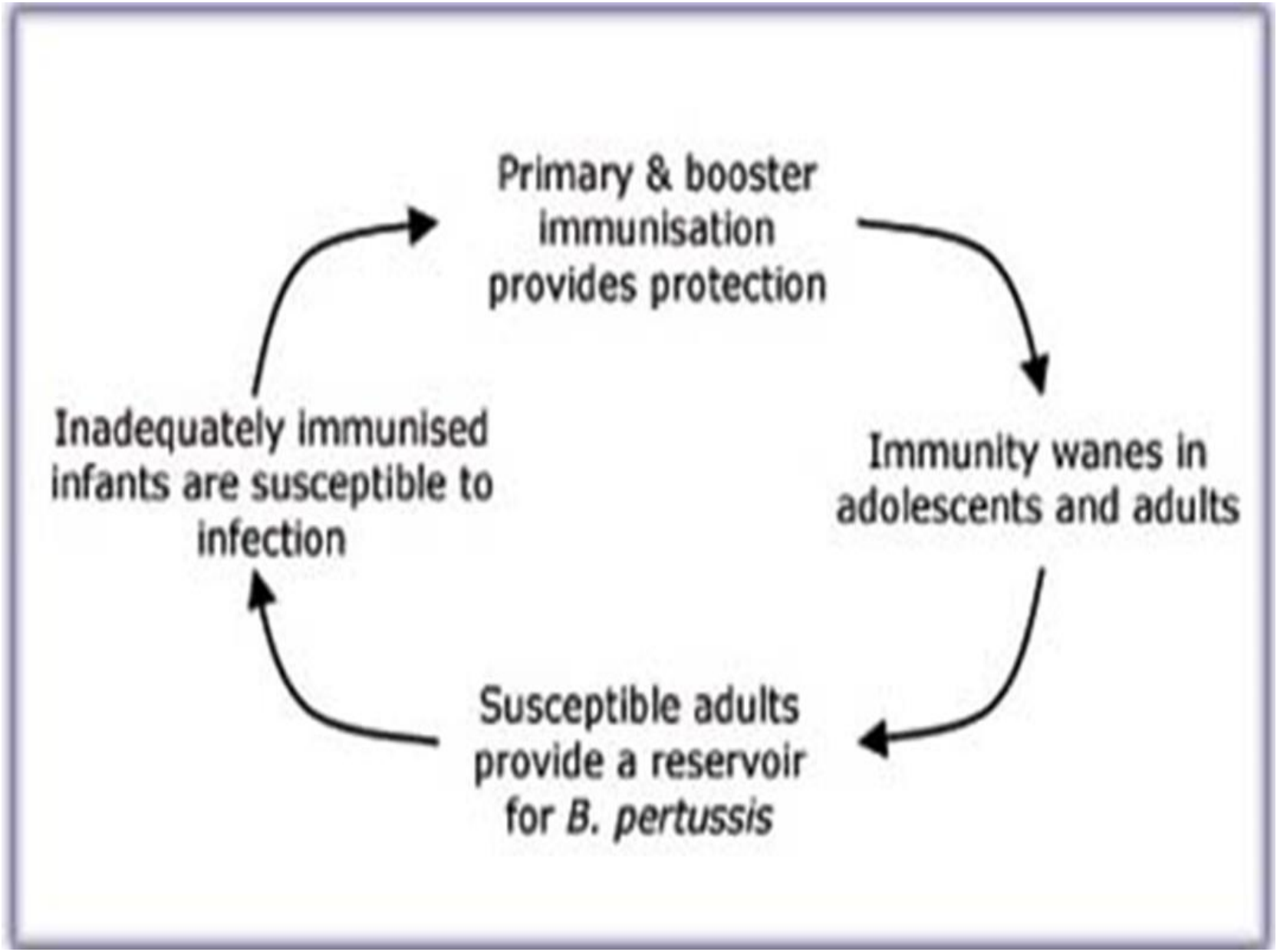
2.The highest around school age [5-7] years, and almost all become immune by the age of 15 years.

3.Sex ;incidence and fatality being more in females than in males.

4-The whooping cough vaccine received as a child in time wears off. This leaves most teenagers and adults susceptible to the infection during an outbreak — and there continue to be regular outbreaks.

In recent years, many cases of whooping cough have been recognized in adults and adolescents due to waning immunity. These individuals are a significant source for the transmission of infection to infants.


Prevaccination Era
Susceptible
Immune
Natural infection
Adolescents and adults
Children
Transmission
Waning maternal antibodies
Placental transfer of maternal antibodies
Infants
Vaccination Era
Susceptible
Immune
Infants
Vaccination
Transmission
Children
Transmission
Adolescents and adults
Waning vaccine immunity


Primary & booster immunisation provides protection
Immunity wanes in adolescents and adults
Susceptible adults provide a reservoir for B. pertussis
Inadequately immunised infants are susceptible to infection

5-A child who has never been vaccinated against pertussis, is 13 times more likely to suffer from an infection of *Bordetella pertussis* than is a child who is up-to-date on his or her vaccines.

6-More than 80% of cases occurred in fully vaccinated children. Children only partially vaccinated were 1.9 times more likely to contract whooping cough than fully vaccinated peers.

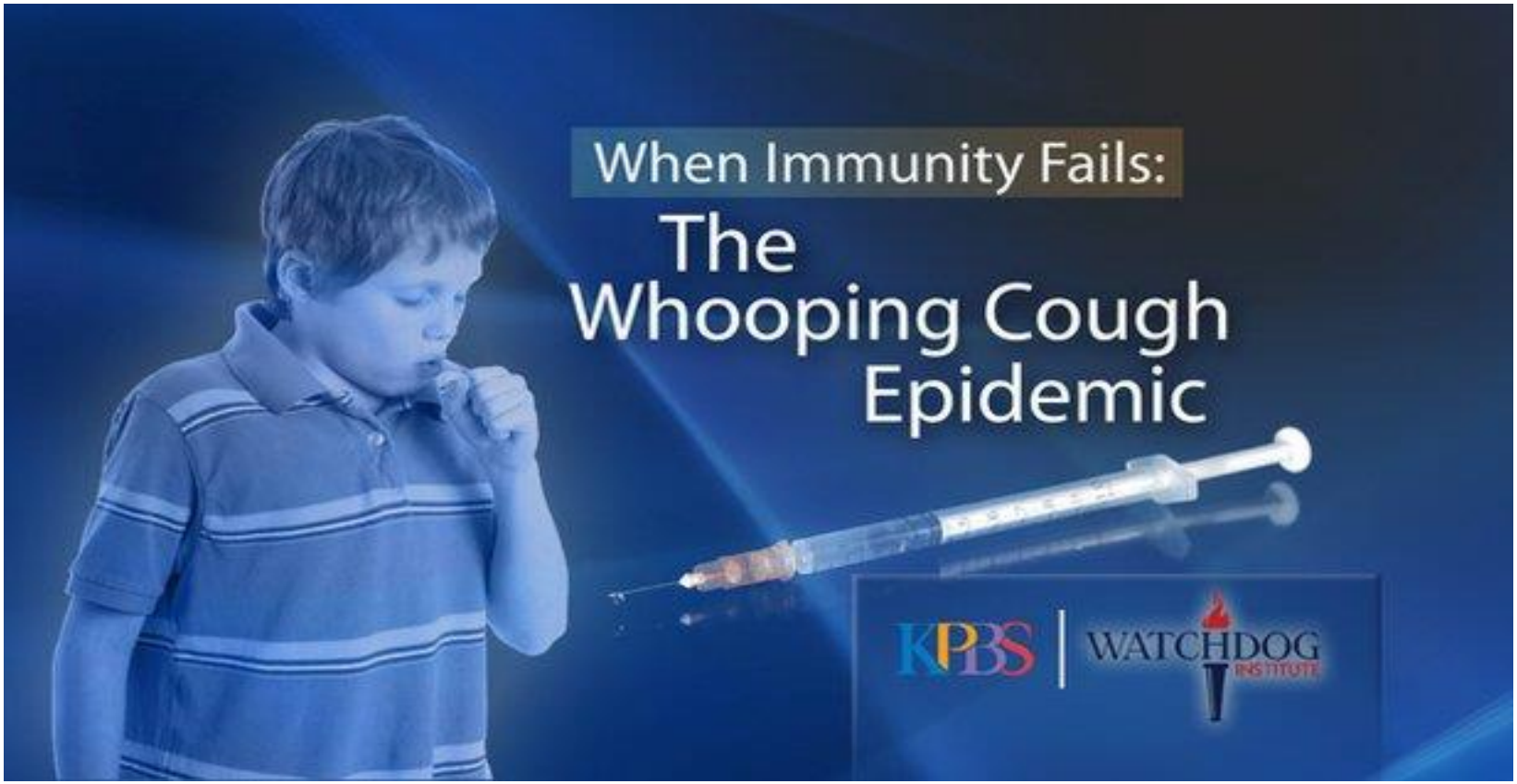
Despite a long-standing vaccination program, pertussis remains highly prevalent in many countries.

Pertussis is the least well controlled of all vaccine-preventable diseases, and epidemics occur every 3–5 years.

The United States of America is the top country by pertussis cases in the world.
As of 2020, pertussis cases in the United States of America was 18,617 that accounts for 29.05% of the world's pertussis cases.
The top 5 countries (others are India, Russian Federation, China, and Australia) account for 70.50% of it

During the last decades, multiple epidemics of pertussis took place in many countries including those with high vaccination coverage

Reasons for rising incidence



Reasons for rising incidence

- **Waning of vaccine- and infection-induced immunity (wanes after 5-10 years)**
  - **~ 15 years after active disease**
  - **~ 5-10 years after vaccination**

Waning immunity due to replacement of the highly effective but reactogenic whole-cell vaccines with acellular vaccines

- **Increased recognition and reporting**
- **Availability of better diagnostic tests**
- **?Use of less potent pertussis vaccines**
- **? Emergence of vaccine-resistant strains**

Centers for Disease Control and Prevention researchers in USA say that the vaccine used for whooping cough is less effective because the bacteria behind the disease has mutated.
The researchers analyzed lab samples from whooping cough patients between 2000 and 2013 and found that Bordetella pertussis, which causes whooping cough, has undergone genetic changes over time.

PREVENTION and CONTROL

Prevention

General preventive measures of respiratory [droplet] infection must be followed, but specific prevention is the effective measures by immunization [active & seroprophylaxis], and chemoprophylaxis.

- Active Immunization: **By Pertussis vaccine.**

Two types of vaccines against pertussis exist: whole-cell vaccines (wP), developed in the 1940s, containing the entire inactivated Bordetella pertussis organism, and acellular vaccines (aP)

The main aim of pertussis vaccination is to reduce the risk of severe pertussis in infancy.

THEY SHOULD BE FAMOUS

They created the first whooping cough vaccine


Grace Eldering


Loney Gordon


Pearl Kendrick

ALMOST NO ONE KNOWS THEIR NAMES

You can change that by sharing this poster

RtAVM

Immunity against pertussis

- **Vaccination against pertussis does not give life-long immunity**
- **Individuals who have had pertussis can become re-infected and spread infection to others**
- **This spread of infection is important particularly in children too young to be vaccinated**

The w(w=whole cell) vaccines are produced from cultures of selected B. pertussis strains that are subsequently killed, usually by heating or treatment with formalin.

- **wPs are still used for primary vaccination doses in developing countries.**

- **These vaccines are generally not used in older children because of concerns regarding reactogenicity.**

- **Vaccines containing wP must not be frozen. They should be stored at 2–8 °C.**

- **Studies to date indicate that aP vaccines are more effective than low-efficacy wP vaccines**

Vaccine safety

Vaccination with wP vaccines is frequently associated with minor local and systemic adverse reactions (1 in 2–10 vaccinations), such as local redness and swelling, induration, fever and agitation.

- **Prolonged crying and febrile convulsions are not uncommon**

- **As local reactions tend to increase with age and with the number of injections, wP-containing vaccines are usually not recommended for use in children aged ≥7 years, adolescents and adults.**

- **To reduce the reactogenicity of booster doses, aP-containing vaccines with reduced concentrations of the antigens have been formulated for use in adolescents and adults.**

Vaccination of health-care workers

Several studies have shown that health-care workers (HCWs) are at increased risk of pertussis, and that transmission in health-care settings poses substantial risk of infection for infants and immunocompromised individuals

Give aP vaccine.

Vaccination during pregnancy

If a mother has a dose of whooping cough vaccine from 20 weeks of pregnancy, this can provide good protection for the baby until they can have their first vaccine at 6 weeks of age. aP vaccine is used for pregnant women.

Age &dose	Vaccine
After birth(1st week	
2 Months 1st dose	(الخماسي)[Panta -1] (DwPT+ Hib , HBV)& Rota virus & OPV-1+ Pneumococcal(PCV13-1)
4Months 2nd dose	Panta-2 [DwPT, Hib , HBV] , IPV-1 Rota virus-2 OPV-2+ Pneumococcal (PCV13-2)
6Months 3rd dose	[D wPT, Hib , HBV] . IPV-2, OPV-3 + Pneumococcal(PCV13-3)
9Months	
12 Months	……
18 Months	[DwPT +Hib] الرباعيTetra MMR , OPV 1st booster , vit A (200.000IU)
4- 6 Years	DwPT الثلاثي MMR(2nd dose)+vit A (200.000IU)

- **Health Education:** of parents, for basic knowledge of the disease & the protective value and precautions with the vaccination.

- **Seroprophylaxis:** antipertussis immunoglobulin; 2.5 ml IM, can be given to protect susceptible intimate contacts, especially infants & young children. Protective value, however, is not certain. So far, there is no evidence of its efficacy in well-controlled trials, so chemoprophylaxis is preferred.

- **Chemoprophylaxis:**

Oral erythromycin or clarithromycin can be given in proper dosage, for 5 days after the last contact with the case.

- **Antibiotics can be used for 2 purposes in the control and prevention of pertussis :**

1. **Treatment to modify clinical symptoms of pertussis by administering to symptomatic patients**

2.Prevention of secondary spread of pertussis by administering to:

- **Symptomatic patients (treatment) and interrupting infectiousness and transmission by eliminating the organism from the respiratory system.**
- **Asymptomatic contacts (prophylaxis) and interrupting transmission by eliminating any organisms that may have been contracted**

- **If within 3 weeks of exposure, prophylaxis recommended for all household and close contacts (regardless of age or vaccination status).**

✓ **If 3 weeks have passed since exposure, still consider prophylaxis for households with high risk contacts:**

- **Young infants**
- **Pregnant women**
- **People who have contact with young infants**

CONTROL

Control measures are taken for:

- ✓ **Cases**
- ✓ **Contacts**
- ✓ **School**

1- Control of Cases :

✓**Reporting to local health authority.**

- ✓ **<u>Isolation at home</u>; practically difficult to fulfill, since the majority of cases are mild, with no or slight fever, they usually move in the community and go to school, and so spread infection to exposed susceptible children.**

- ✓ **Infants younger than 6 months generally require hospitalization**

Approximately half of babies less than 1 year old who get pertussis need treatment in the hospital.

- ✓ **Cases should be removed from the presence of young infants , especially non immunized infants , until the patients have received at least 5 days of a minimum 14 days course of antibiotics.**

- ✓ **Suspected cases who do not receive AB should be isolated for 3 weeks.**

- ✓ **Concurrent disinfection of respiratory discharges; & any soiled objects, and terminal cleaning & airing of the room.**

Treatment

- **Primary role of treatment is to accelerate clearance of organisms and limit transmission**
  - **Treat as late as 3 weeks after cough onset if age >1 year**
  - **Treat as late as 6 weeks after cough onset if age <1 year**
- **Treatment during catarrhal or early paroxysmal stage *may* modify duration and severity of illness**
- **Otherwise treatment generally does not affect clinical course**

- **The antibiotic erythromycin or azithromycin is a front-line treatment .**

Newer macrolides are frequently recommended due to lower rates of side effects.

- **Trimethoprim- sulfamethoxazole may be used in those with allergies to first line agents or in infants who have a risk of pyloric stenosis from macrolides.**

- **Effective treatments of the cough associated with this condition have not yet been developed**

- ✓ **Proper feeding**

- ❖ **Release :** **pupils can return to school ; with proper chemotherapy [one week after starting AB], with no ,or not sure of chemotherapy [3weeks after onset of whooping stage, and satisfactory general condition]**

2- Control of Contacts :

- **Protection of contacts:** **passive immunization is not effective, and the initiation of active immunization to protect against recent exposure is also not effective.**

Inadequately immunized household contacts less than 7 years of age should be excluded from day care center for 21 days after last exposure or until cases & contacts receive 5 days course of AB

Close contacts under 7 years who not received 4 doses of pertussis vaccine or have not receive a dose within 3years should be given a dose as soon as after exposure as possible.

A 7 days course of erythromycin or clarithromycin for household & other close contacts, regardless of immunization status and age is recommended.

Control of Pertussis in School: when case appear in school:

- **Isolation of cases and return to school according to case management.**
- **Segregation of susceptible family contacts for 2 wks.**
- **Surveillance of susceptible school contacts for 2wk, to exclude any; once respiratory catarrh appears**
- **Surveillance of all school children until no more cases appear [case finding]**
- **Chemoprophylaxis of susceptible family & school contacts**