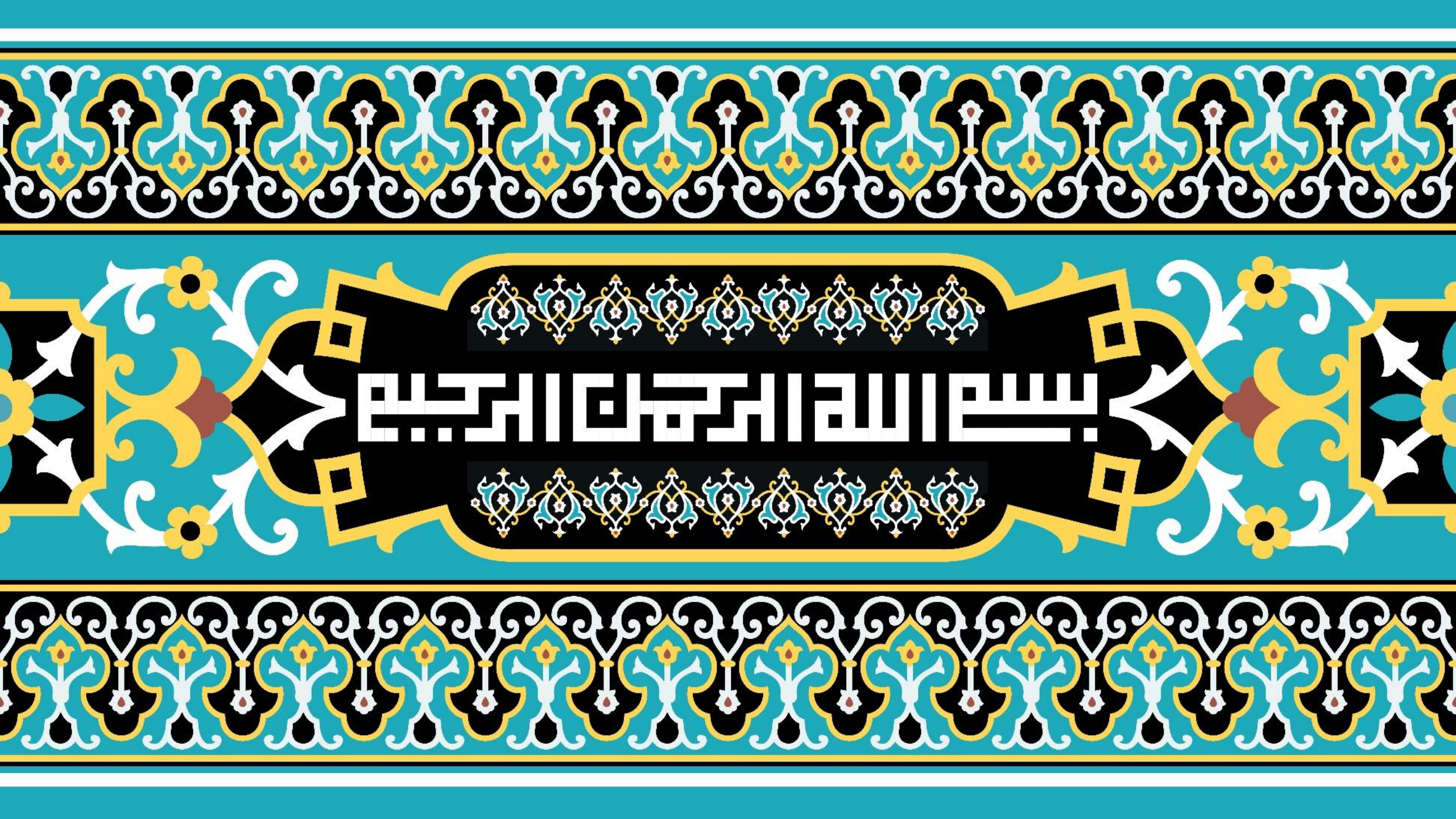
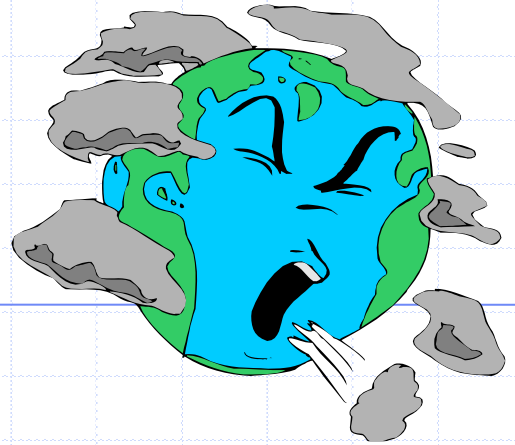

بسم الله الرحمن الرحیم



Pertussis

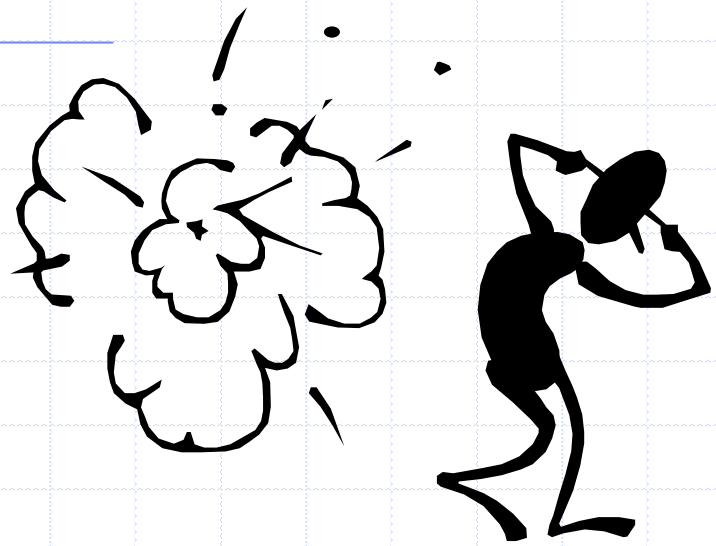
By: Dr. Hamid Rahimi
Pediatric infectious disease specialist

Pertussis syndrome
Whooping cough syndrome

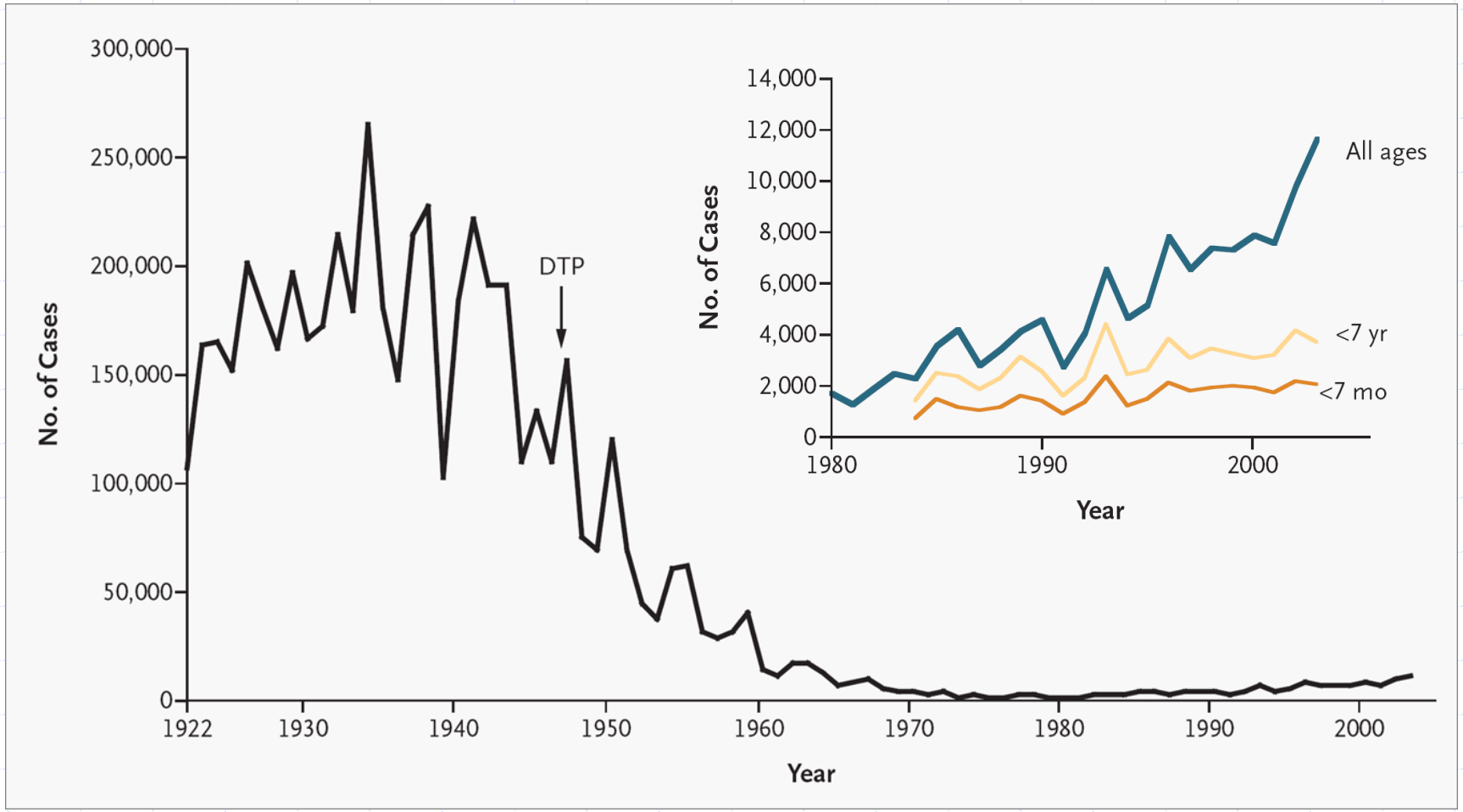
- Classic pertussis (whooping cough syndrome) usually is caused by *B. pertussis*

- Other causes of pertussis syndrome
  - *Bordetella parapertussis*
  - Adenoviruses
  - Influenza virus A & B
  - Parainfluenza virus 1 & 3
  - Mycoplasma pneumoniae
  - Post nasal drip syndrome
  - …

Resurgence of pertussis



Reported Pertussis cases (US,1922 -2003)



Epidemiology

- Each year worldwide
  - 20,ooo,ooo cases of pertussis
  - >200,000 childhood deaths

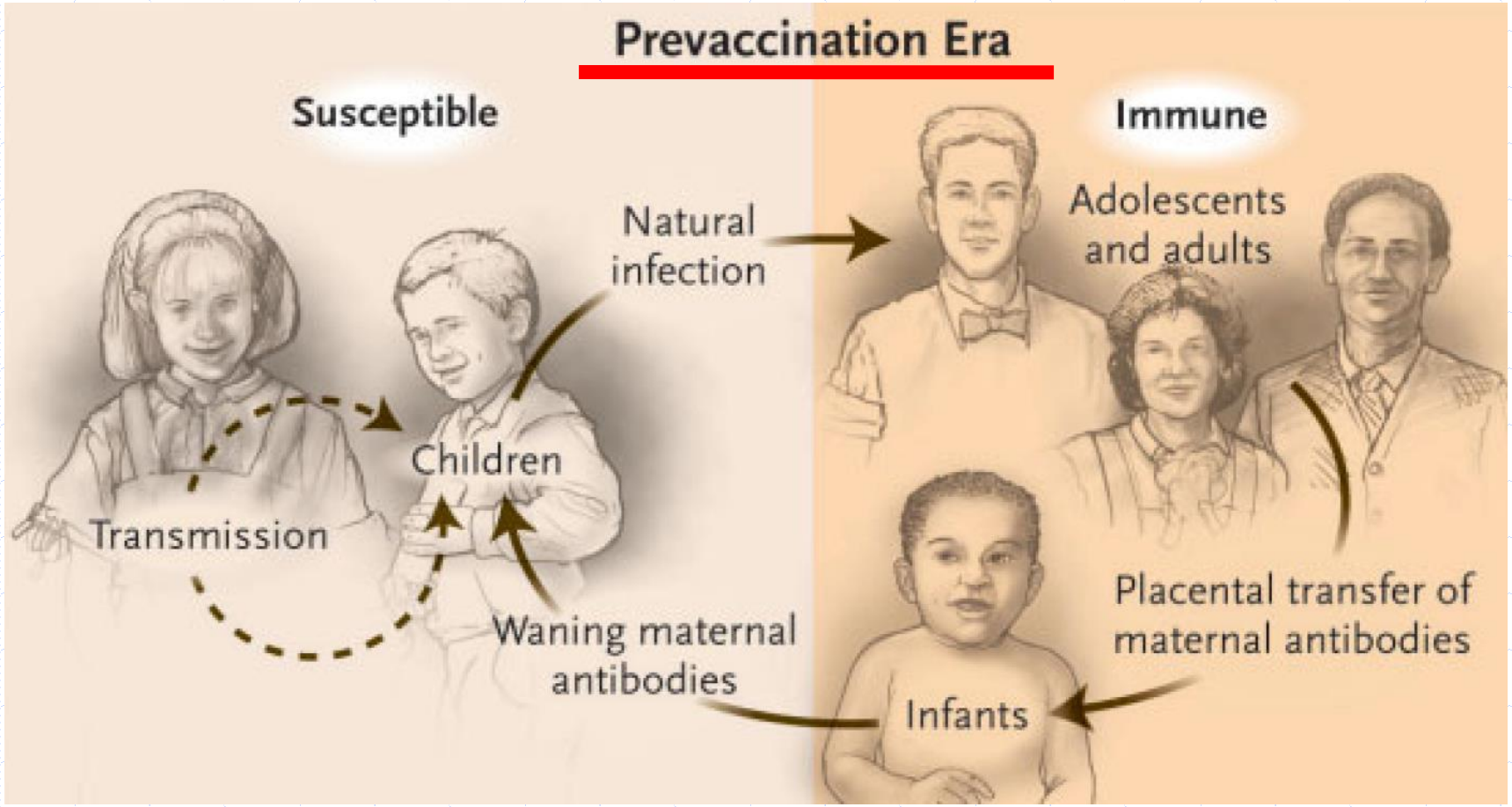
- Diagnosis of pertussis is **underconsidered**, **underproven**, and **underreported**.
  - Pertussis is under reported, 40-160 fold less than actual illness
  - In adolescent & adults asymptomatic infections are 4–22 times more common than symptomatic infections

Studies of prolonged cough illnesses

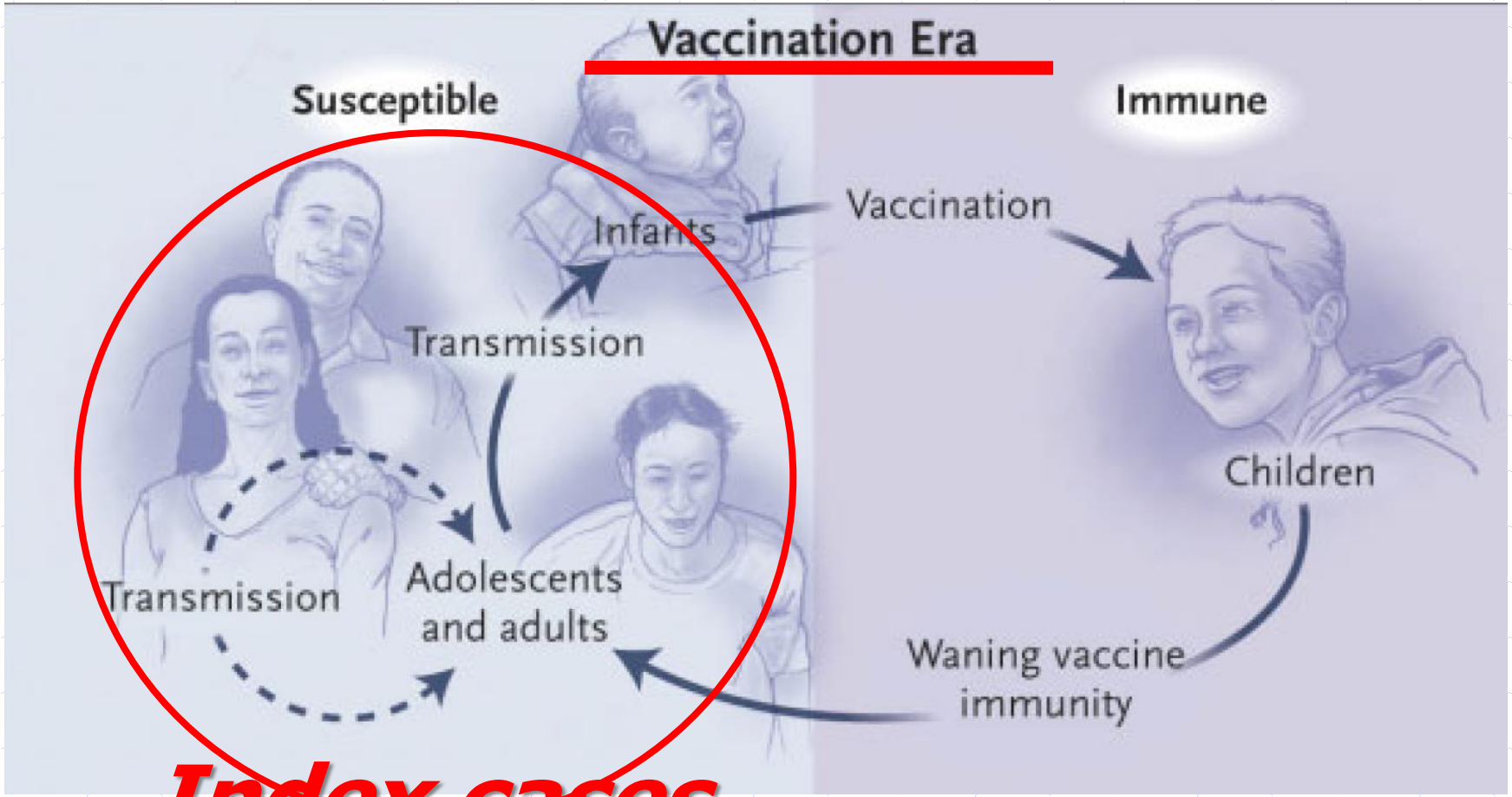
- Prolonged cough illnesses …

  7–17% are due to B. pertussis infection (median, 13%; mean, 12.4%)

Source of Pertussis Acquisition-1



Source of Pertussis Acquisition-2

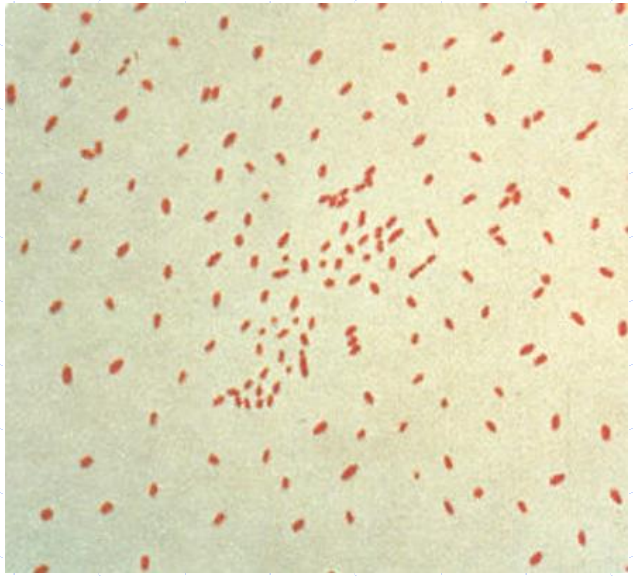


Resurgence of Pertussis

- **Mutation**
- **Waning vaccine-induced immunity**
  - 5 to 7 years after vaccination, leaving adolescents and adults unprotected
- **Waning disease-induced immunity**
  doesn’t last much longer than that of vaccination
- **Enhanced identification**
  - Public health awareness
  - Surveillance
  - Diagnostic programs

Bordetella pertussis, the germ

- Aerobic gram negative rod
- Multiple antigenic and biological products
- Toxin mediated disease- toxins paralyze cilia, cause inflammation-decreased mucus clearing, Impaired chemotaxis
- **Humans are the only host**



Spread

- Close person to person contact via aerosolized droplets from respiratory secretions of patients with disease
- 90% of nonimmune household contacts acquire the disease
- Adolescents and adults are the major source of infection in unvaccinated children (Index cases)

- Infants and young children are infected by older siblings who have mild to asymptomatic disease (43% of reported cases)

Wide heterogeneity in disease expression

- Clinical expressions are affected by ...
  - Age
  - Modification of disease by immunization
  - Previous exposure to the organism
  - Antibiotic administration
  - Degree of exposure
  - Concomitant infections with other agents

Clinical Manifestations

- According to previously mentioned factors 3 type of manifestations:
- Prevaccination era in 1-10 years old
  - Classic pertussis (3 stages: catarrhal, paroxysmal, and convalescent stages)
- Postvaccination era
  - Infants (less than 6 months old)
    - Apnea, paroxysamal prolonged cough illness w/ whoop
  - Adolescents & Adults
    - Prolonged bronchitic illness with persistent, nonproductive cough

Clinical Features

- Incubation 7-10 days (5-21)
- Insidious onset with minimal fever

Clinical Features - Classic pertussis

- Incubation 7-10 days (5-21)
- Three Stages: - Catarrhal
  - Paroxysmal
  - Convalescent

Catarrhal Stage

- 1-2 weeks
- Coryza
- Sneezing
- Low grade fever
- Occasional cough
- Often mistaken for common cold or flu

Paroxysmal Stage

- The most distinctive stage of pertussis
- Lasts 2-4 weeks
- Paroxysmal attacks-rapid coughs due to difficulty of expelling thick mucus from airways
- Whoops & possibly cyanosis, vomiting
- **Well in between**

Convalescent Stage

- Gradual resolution of symptoms over 1-2 weeks
- Cough leaves 6-8 weeks
- **Residual cough may persist for months, especially with physical stress or respiratory irritants**

Clinical Features - Infants

- Most severe in infants <6 months
- Atypical presentation
- Apnea most common symptom & whoop is absent
- Hospitalization often needed
- More likely to have central nervous system damage as a result of hypoxia, and secondary bacterial pneumonia
- Lymphocyte predominant, increased white count can match severity of the cough

Clinical Features - Adolescents & adults

- Usually present with a prolonged bronchitic illness with persistent, nonproductive cough that often begins as a nonspecific upper respiratory tract infection.
- In general, adolescents and adults do not have a whoop with the cough, although they may have severe paroxysms.
- **The cough may persist many weeks to months**

Complications

	Percent	
	All cases	(Infants)
Pneumonia	5.2	(25%)
Seizures	0.8	(4%)
Encephalopathy	0.1	(1%)
Death	0.2	(0.3-1.3%)
Hospitalization	20	(82%)

(all cases reported to CDC 1997-2000)

- Infant Case fatality rate:
  - 1.3% in infants <1 month
  - 0.3% in infants 2-11 months

Complications in young children

- The most frequent complication is pneumonia caused by B. pertussis itself or resulting from secondary bacterial infection.
- The force of the paroxysm may produce pneumomediastinum, pneumothorax, or interstitial or subcutaneous emphysema; epistaxis; hernias; and retinal and subconjunctival hemorrhages.
- Most children recover normal pulmonary function with complete healing of the respiratory epithelium.
- **Most permanent disability is a result of encephalopathy.**

Diagnosis

- History
  - Should be suspected in any with pure or predominant complaint of cough, especially if no …
    - Fever, malaise or myalgia, exanthem or enanthem, sore throat, hoarseness, tachypnea, wheezes, and rales
    - APNEA in <3 months old
- **Clinical case definition**

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

Clinical Criteria

- In the absence of a more likely diagnosis, a cough illness lasting ≥2 weeks, with at least one of the following signs or symptoms:
- Paroxysms of coughing; OR
- Inspiratory whoop; OR
- Post-tussive vomiting; OR
- Apnea (with or without cyanosis) (FOR INFANTS AGED <1 YEAR ONLY)

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

- **Laboratory Criteria for Diagnosis**
  - Isolation of *B. pertussis* from a clinical specimen
  - Positive PCR for pertussis
- **Epidemiologic Linkage**
  - Contact with a laboratory-confirmed case of pertussis

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

- **Confirmed**
- **1 -** Acute cough illness of any duration, with isolation of *B. pertussis* from a clinical specimen.

- **OR 2 -** Cough illness lasting ≥ 2 weeks, with
  - At least one of the following signs or symptoms:
    - Paroxysms of coughing; or
    - inspiratory "whoop"; or
    - Post-tussive vomiting; or
    - Apnea (with or without cyanosis) (FOR INFANTS AGED <1 YEAR ONLY)
  - And
    - Polymerase chain reaction (PCR) positive for pertussis.
  - OR
    - Contact with a laboratory-confirmed case of pertussis

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

- **Probable - 1**
- In the absence of a more likely diagnosis, a cough illness lasting ≥2 weeks, with
  - At least one of the following signs or symptoms:
    - Paroxysms of coughing; or inspiratory "whoop”; or
    - Post-tussive vomiting; or
    - Apnea (with or without cyanosis) (FOR INFANTS AGED <1 YEAR ONLY)
  - And
    - Absence of laboratory confirmation;
    - No epidemiologic linkage to a laboratory-confirmed case of pertussis.

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

- **Probable - 2**
- OR, FOR INFANTS AGED <1 YEAR ONLY: Acute cough illness of any duration, with
  - At least one of the following signs or symptoms:
    - Paroxysms of coughing; or
    - Inspiratory "whoop"; or
    - Post-tussive vomiting; or
    - Apnea (with or without cyanosis)
  - And Polymerase chain reaction (PCR) positive for pertussis.

Pertussis / Whooping Cough (Bordetella pertussis) 2014 Case Definition

- **Probable - 3**
- OR, FOR INFANTS AGED <1 YEAR ONLY: Acute cough illness of any duration, with
  - At least one of the following signs or symptoms:
    - Paroxysms of coughing; or
    - Inspiratory "whoop"; or
    - Post-tussive vomiting; or
    - Apnea (with or without cyanosis)
  - And Contact with a laboratory-confirmed case of pertussis.

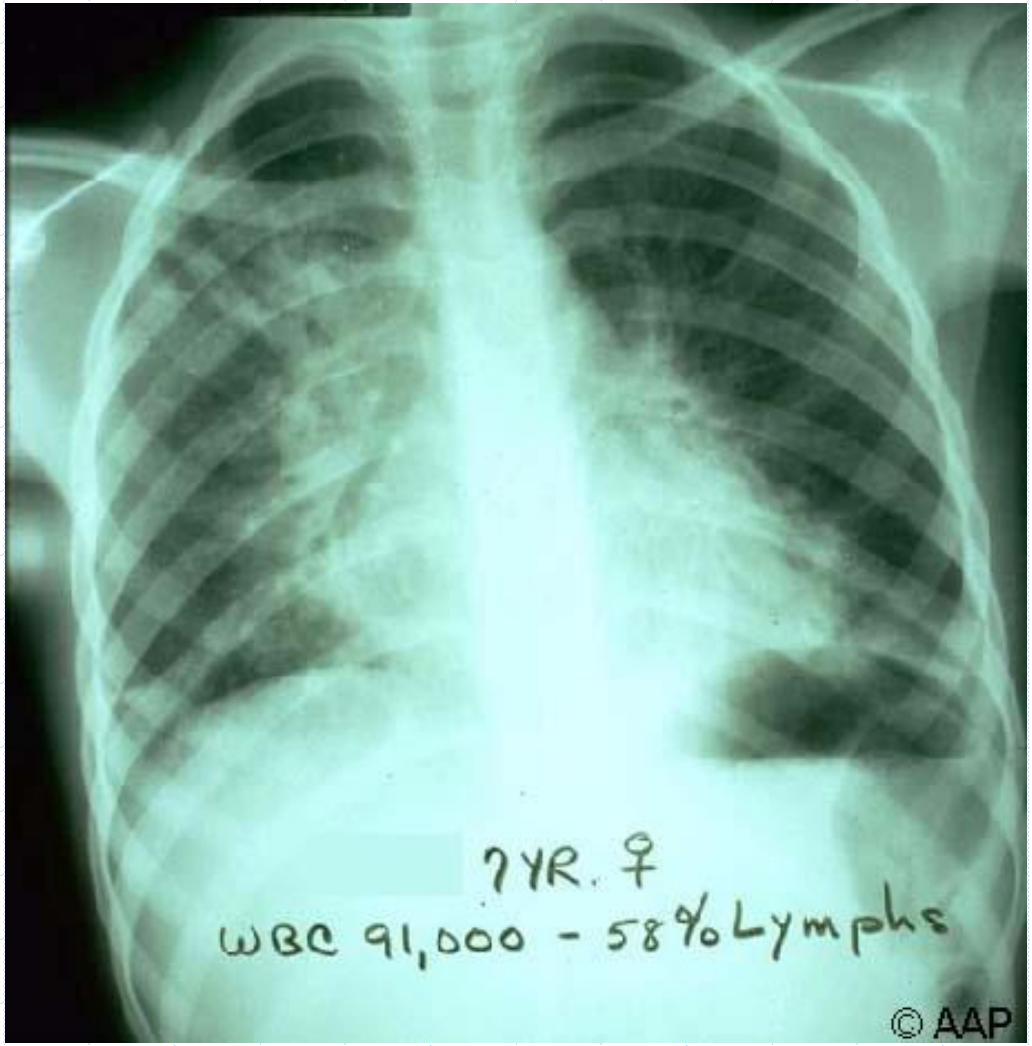
CDC and Prevention case definition for pertussis (Bordetella pertussis; whooping cough)

Clinical criteria
•Cough illness lasting ≥2 weeks, without a more likely diagnosis and at least one of the following:Paroxysms of coughing, **or** •Inspiratory whoop, **or** •Posttussive vomiting, **or** •Apnea (with or without cyanosis)
Laboratory criteria
Isolation of *Bordetella pertussis* from a clinical specimen
Positive PCR for *B. pertussis*
Epidemiologic linkage
Contact with a laboratory-confirmed case of pertussis*
Case classification
Confirmed
Acute cough illness of any duration with isolation of *B. pertussis* from a clinical specimen, **or**
Acute cough illness of any duration with PCR positive for pertussis
Probable
Clinical criteria (as above) **and** absence of a more likely diagnosis, **or**
•Acute cough illness of **any duration** with at least one of the following: Paroxysms of coughing •Inspiratory whoop •Posttussive vomiting •Apnea (with or without cyanosis) •**and:**Contact with a laboratory-confirmed case

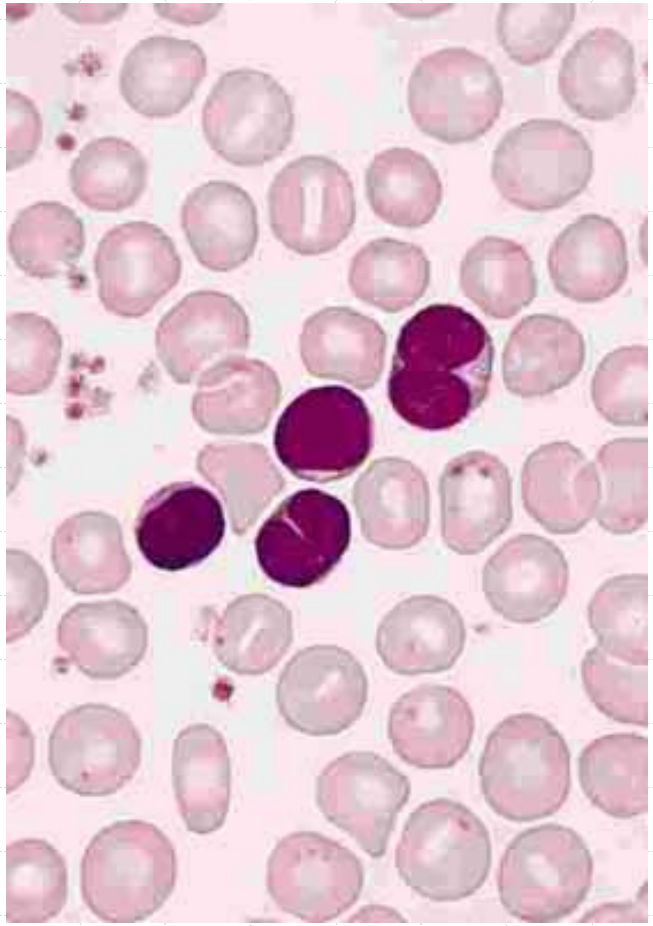
Diagnosis

- Non specific laboratory data
  - Chest X-ray
  - CBC
    - Leukocytosis with absolute lymphostosis
    - No ⇧ in PMN, Eos.
    - Thrombocytosis

Pertussis - CXR



Pertussis – Atypical Lymphocytosis



Diagnosis

- Gold standard: Culture
  - Less sensitive after 2 weeks
  - Nasopharyngeal swabs or aspirates
  - Dacron or calcium alginate swab
  - Regan-Lowe charcoal agar
- Polymerase Chain Reaction (PCR)
  - Rapid/Sensitive/Specific
- Direct fluorescent antibody (DFA) staining is **not recommended**
- < 10% of any of these tests is positive in partially or remotely immunized individuals tested in the paroxysmal stage

Diagnosis - Serologic tests

- When tested in acute and convalescent samples most sensitive tests in immunized individuals and are useful epidemiologically
  - Not generally available
  - **Not helpful during acute illness**
  - Difficult to interpret in immunized individuals

- Antibody to pertussis toxin elevated >2 SD above mean of the immunized population is the most reliable result indicating recent infection.

Pertussis ???

- Typical (Classic) Pertussis
- Atypical Pertussis
- Asymptomatic infections

- Misdiagnoses of pertussis as …
  - Mycoplasma pneumoniae, Chlamydia pneumoniae infection, laryngitis, URT infection, sinusitis, asthma, bronchitis, chronic bronchitis & …

Pertussis like syndromes

- Bordetella parapertussis and Bordetella holmesii
- Mycoplasma pneumoniae
- Chlamydophila pneumoniae
- Adenoviruses
- Respiratory syncytial virus.

Management

- Supportive
- Antibiotics
- Prevention
  - Prophylaxis
  - Vaccination

Hospitalization

- All < 3 months old
- 3 – 6 months old if severe paroxysms
- All with significant complications

- Prematurely born young infants and children with underlying cardiac, pulmonary, muscular, or neurologic disorders have a high risk for severe disease.

Antibacterial treatment - 1

- Pertussis is one of a few bacterial infections for which antibiotic treatment has little effect on the course of the illness.
- Treatment lessens the severity of pertussis if given early in disease, before the cough is well established and usually before the illness is recognized as pertussis

Antibacterial treatment - 2

- 80-90% of patients with untreated pertussis will spontaneously clear B. pertussis from the nasopharynx within 3 - 4 weeks from onset of cough
- Untreated and unvaccinated infants can remain culture-positive for >6 weeks

- Treatment administered early in the course of illness can ...
  - Reduce the duration and severity of symptoms
  - Lessen the period of communicability

Antibacterial treatment - 3

- Macrolides
  - Erythromycin, Azithromycin (Zithromax), and clarithromycin
  - Treatment duration
    - Usually 14 days with erythromycin sulfate, newer Macrolides 5-7 days
  - Azithromycin eradicates naso-pharyngeal carriage the fastest
  - Hypertrophic pyloric stenosis has been reported with oral Erythromycin in infants younger than 6 weeks
- Trimethoprim-sulfamethoxazole is an alternative to erythromycin-resistant strain, or for intolerance to macrolides
- Penicillins, first and second generation cephalosporins are **not** effective

Supportive care

- Hospitalized patients need to be on Droplet Isolation for 5 days after therapy
- Monitor exposed children for respiratory symptoms for 20 days
- Children may return to school after 5 days of appropriate antibiotic therapy

Prevention

- Prophylaxis
- Vaccination

Prevention - Prophylaxis

- All household contact & other colse contacts
  - Azithromycin for 5 days or clarithromycin or erythromycin for 7-14 days
  - Close contact <7 years old
    - Vaccination **if**
      - 3rd dose >6 months
      - 4th dose ≥ 3 years
  - Close contact 7-10 years of age should receive Tdap

Prevention – Immunization (aP)

- Vaccination (acellular)
  - Point efficacy 70-90%
  - DTaP vaccine is recommended at 2, 4, 6, and 15-18 months, with a booster at 4-6 years.
  - A single booster dose of Tdap vaccine is recommended at 11-12 years or once for all adults.
  - A booster dose of Tdap vaccine is recommended for pregnant women with each pregnancy, preferably in the third trimester, to provide higher levels of antibodies to the infant via transplacental transfer.

Pearls for Practitioners

- Pertussis typically lasts 6–8 weeks; it is marked by catarrhal, paroxysmal, and convalescent stages and can lead to apnea and severe respiratory distress in infants.
- Vaccination with DTaP and Tdap have reduced the incidence of pertussis, but pertussis remains a common infection among infants younger than 6 months.
- Pertussis is associated with lymphocytosis and post-tussive emesis.