

# Case 4 Bordetella pertussis

Body Systems  
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## Signs & Symptoms

**Babies**

- No coughing symptom
- Apnea (pause in breathing)
- Turn blue

**Catarrhal Stage**

05

- Lasts 1-2 weeks
- **HIGHLY CONTAGIOUS**
- Cold-like symptoms
- Runny nose
- Low grade fever
- Mild occasional cough

**Paroxysmal Stage**

05

- Lasts 1-6 weeks, up to 10
- Fits of cough followed by "whoop" sound
- Coughing more frequent at night
- Vomiting after cough fits
- Exhaustion after cough fits

**Convalescent Stage**

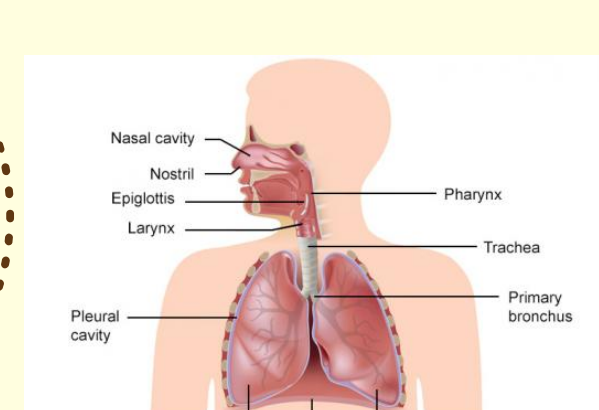
05

- Lasts between weeks 8-10
- Susceptible to other respiratory infections
- Recovery is gradual
- Fits of coughing may return

**Other Symptoms**

- Salivation
- Teary-eyed

## Body System Affected

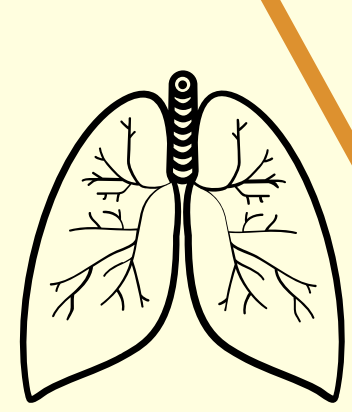


- Respiration/gas exchange
- Filtration
- Immune system
- Phonation
- Olfaction
- Humidification

## Respiratory System

- The respiratory system permits oxygen intake and carbon dioxide production
- Goblet cells line respiratory cell epithelial lining and secrete mucin, which combines with water to yield mucus
- Mucus acts in a defensive/protective manner by moistening the airways of the respiratory system.
- Mucus additionally yields mucociliary escalator clearance of infectious particles
- Continuously beat mucus up and out of throat, as well as sweep pathogens along the respiratory lining and out of the nose, bronchi, and bronchioles
- Inspiration and expiration via physical (pressure, volume, etc.)
- Differentials (diaphragm and intercostal muscles) beginning at the nose and ending at the lungs

## Normal Function



## Disturbances

- Results in unusual amount of mucus accumulation
- can result in co-infection of the respiratory system with other pathogens
- B. pertussis lung inflammation and swelling decreases the ability/capacity to draw breath in
- Pertussis attaches to upper respiratory tract epithelial lining yielding inflammation and swelling, which disturbs the normal physiological function (to moisten, protect, prevent pathogen invasion) of the epithelial cells.
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- Air is inspired through swollen airways that are partially closed as opposed to open airways that are not swollen

## Treatment

### Antibiotic Therapy

- Antibiotic treatment is initiated early in the infection
- Reduce severity of infection
- Help clearance of infection

Macrolides act to inhibit protein synthesis within the bacterium

- Reversibly binds to the P site of the 50S subunit on its ribosome
- Inhibits bacterial growth by stopping translation
- Used in patients 1 month or older, but for those infants who may acquire pertussis at a younger age, azithromycin is the preferred treatment as it is not associated with infantile hypertrophic pyloric stenosis (IHPS)

1. Azithromycin
2. Erythromycin
3. Clarithromycin
4. Trimethoprim
5. Sulfamethoxazole

### Azithromycin

- Treatment is recommended in a 14-day regime
- Observed to eradicate B. pertussis from the nasopharynx with short term antibiotic treatment
- Azithromycin is potent against many bacterial strains as it binds and inhibits erythromycin-strains
- Targets AHLs and biofilms by inhibiting LasR-dependent gene expression and inhibits biofilm expression
- Able to reach higher intracellular concentrations than erythromycin, thus increasing its efficacy and duration of action

### Trimethoprim

- Binding to dihydrofolate reductase enzyme and inhibition of the reduction of tetrahydrofolic acid (THF) starves the bacteria of nucleotides necessary for DNA replication because it affects the thymidine synthesis pathway
- The drug's affinity for bacterial dihydrofolate reductase is several thousand times greater than its affinity for human dihydrofolate reductase, which makes it safe for humans
- Often combined with sulfamethoxazole as it displays synergistic effects

## Toxins

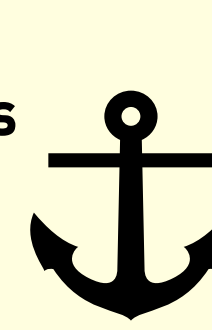
### Adenylate cyclase Toxin

- blocks phagocytes from getting to the site of infection
- Prevents bacterial killing once the macrophages engulf the pathogen
- induces host phagocyte apoptosis atypical from resting uninfected states

### Pertussis Toxin

- Anchors Bordetella pertussis bacteria to epithelial lining
- Increases the amount of T cells in the blood by increased T cell division
- Pertussis toxin blocks them from leaving the blood/migrating into tissues to act, causing T cell build-up in the blood.
- Induces sensitivity to histamine (inflammatory molecule) in blood vessels and respiratory system
- Results in ease for fluid to seep into airway tissues
- Increased fluid causes airway swelling making breathing difficult and yields the characteristic "whooping"

1. Filamentous hemagglutinin
2. Pertactin
3. Agglutinin



Anchor Bordetella Pertussis pathogen to the respiratory epithelium, and allow it to attach and initiate damage against respiratory epithelial cells in a manner which diminishes cell function

### Heat Labile Toxin

- yields strong vasoconstrictive effects in the blood
- Cause increased blood pressure during the early phase of pertussis

### Tracheal Cytotoxin

1. Paralyzes the cilia of ciliated cells of the respiratory system, which yields loss of cilia sweeping function
2. The normal sweeping function of cilia move mucus and bacteria along the airways, acting as a defensive barrier preventing pathogenic penetration, damage, and/or bacterial colonization of the respiratory epithelial lining
3. Paralysis of the cilia permits pertussis adherence & mucus build up, which triggers violent persistent coughing, choking and sometimes vomiting

Chronic cough induces inflammatory molecule secretion i.e. histamine, prostaglandin and pro-inflammatory cytokine release. These molecules disturb normal physiological functioning by inducing chronic inflammation, chronic swelling, as well as damage and death of cells and cilia lining the respiratory system (goblet and epithelial cells), altogether yielding decreases in defense and disturbance to mucociliary action.