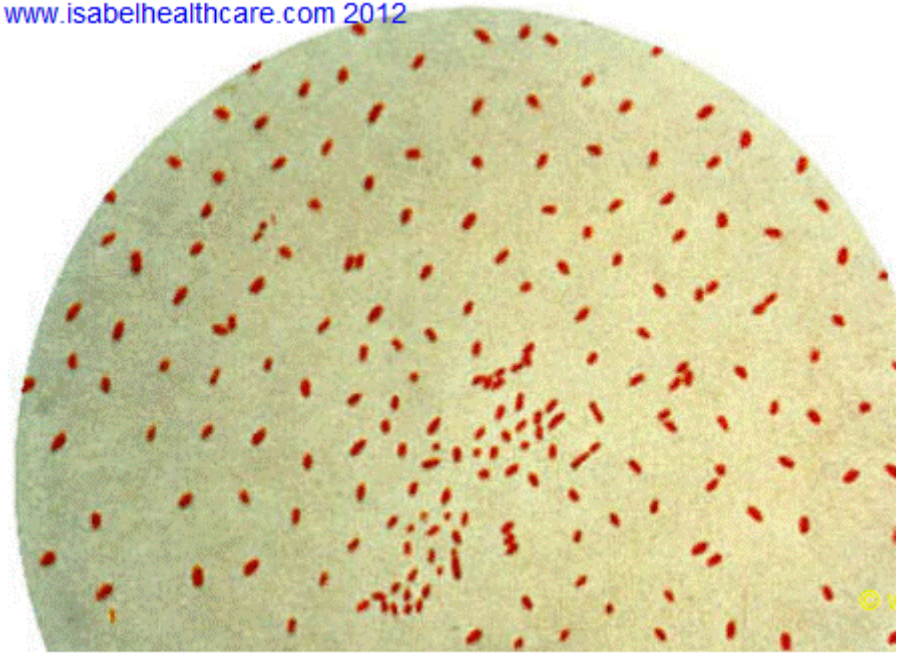
Bordetella

- Bordetella named after Jules Bordet , identified small ovoid bacillus causing whooping cough in the sputum of children suffering from the disease.
- 3 species
  - ✓ Bordetella pertussis
  - ✓ Bordetella parapertussis
  - ✓ Bordetella bronchospecticum
-

Bordetella Pertussis

- **Morphology** – small, ovoid coccobacillus, , nonmotile, nonsporing
- capsulated in first culture, but tends to lose capsule on repeated cultivation ; capsule doesn't swell in the presence of the antiserum.
- in culture films the bacilli tends to be arranged in loose clumps, with clear spaces in between giving a ' thumb print ' appearance.
- meta chromatic granules can be demonstrated.



Bordetella Pertussis

Culture characteristics

- ✓ aerobic , 37° C
- ✓ Bordet – Gengou glycerine – potato – blood agar ; blood added to neutralise inhibitory materials formed during bacterial growth ; growth takes 48- 72 hours, bisected pearls or mercury drops.
- ✓ confluent growth presents as aluminum paint appearance.

Bordetella Pertussis

Antigenic properties

- Bordetella possess genus specific and species – specific **surface agglutinogens** associated with capsular K Ags or fimbriae.
- 14 agglutinating factors have been identified based on agglutinin absorption test.
- Factor 7 is common to all three mammalian species of bordetella.
- Factor 1 to 6 are found only in strains of B. pertussis.
- strains causing infection belong to types 1, 2, 3; vaccine present.
- useful in serotyping & epidemiological studies.

Bordetella Pertussis

Antigenic properties

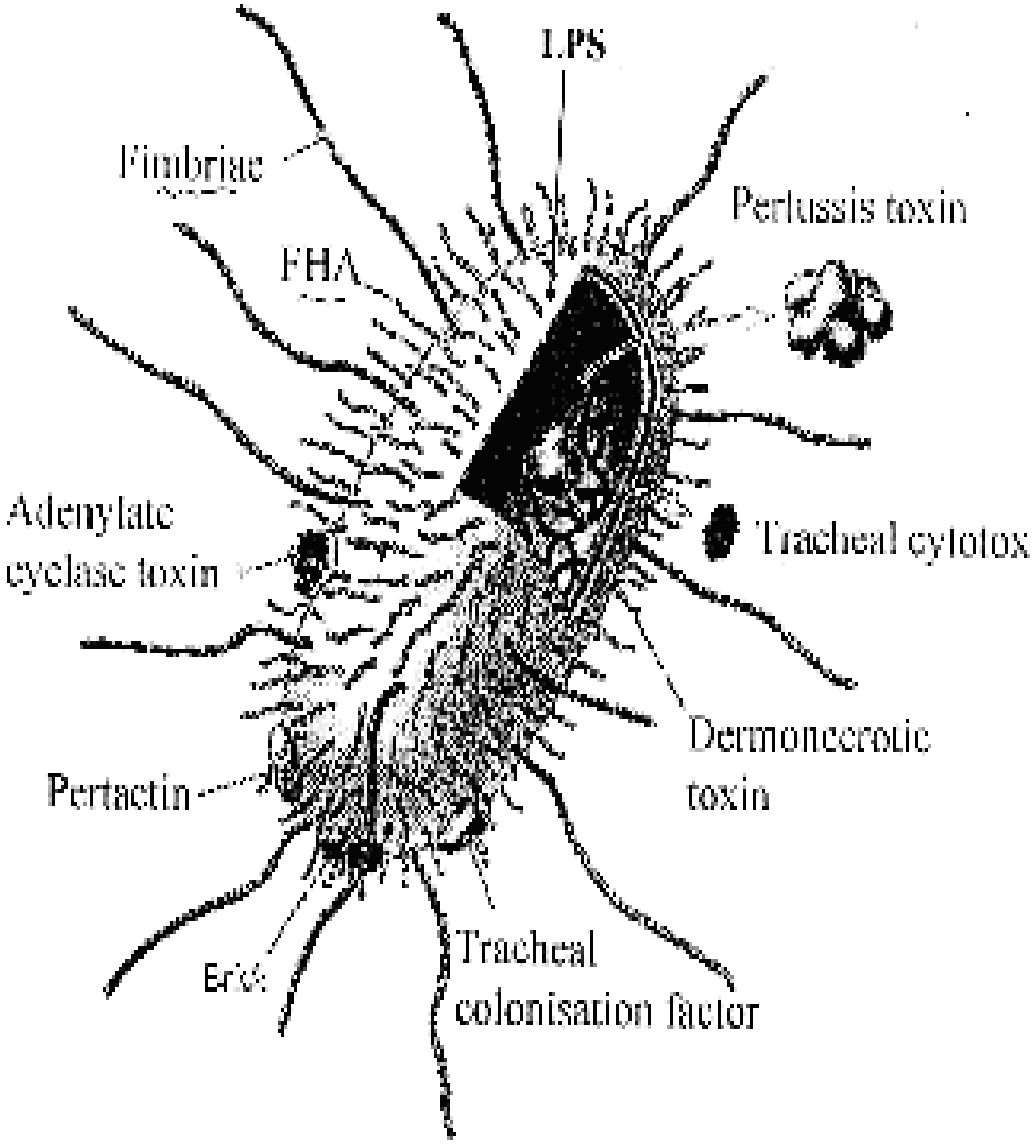
- **pertussis toxin** – plays an important role in pathogenesis of whooping cough, protein composed of six subunits ; A-enzymatic active moiety & B subunit – binding component.
- it can be toxoided . PT toxoid is a major component of acellular pertussis vaccine.
- diverse biological & biochemical properties.
- **Filamentous haemagglutination (FHA)-** it facilitates adhesion of B. pertussis and other bacteria like H. influenzae and pneumococci to respiratory epithelium ; piracy of adhesions.

Bordetella Pertussis

Antigenic properties

- Adenylate cyclase
- **LPS**
- **Peractin** – is an outer membrane protein Ag ; virulent strains
- B. pertussis undergoes a smooth to rough variation ; on subculture , undergo progreesive loss of surface Ag , pass through Phases II, III and IV.

Ca



Alison Weiss, ASM News, 1997

Virulence Factor	Biologic Effect
Adhesins	
Filamentous hemagglutinin	Binds to sulfated glycolipids on ciliated cell membranes; binds to CR3 on surface of polymorphonuclear leukocytes and initiates phagocytosis.
Pertussis toxin	S2 subunit binds to glycolipid on surface of ciliated respiratory cells; S3 subunit binds to ganglioside on surface of phagocytic cells.
Pili	Binds to mammalian cells. Role in disease is unknown.
Pertactin	Binds to mammalian cells. Role in disease is unknown.
Toxins	
Pertussis toxin	S1 subunit adenosine diphosphate–ribosylates host cell G protein, causing deregulation of host cell adenylate cyclase; toxin inhibits phagocytic killing and monocyte migration.
Adenylate cyclase/hemolysin toxin	Increases intracellular level of adenylate cyclase and inhibits phagocytic killing and monocyte migration.
Dermonecrotic toxin	Causes dose-dependent skin lesions or fatal reactions in experimental animal model. Role in disease is unknown.
Tracheal cytotoxin	A peptidoglycan fragment that kills ciliated respiratory cells and stimulates the release of interleukin-1 (fever).
Lipopolysaccharide	Two distinct lipopolysaccharide molecules with either lipid A or lipid X; activates alternate complement pathway and stimulates cytokine release. Role in disease is unknown.

Bordetella Pertussis

Pathogenicity

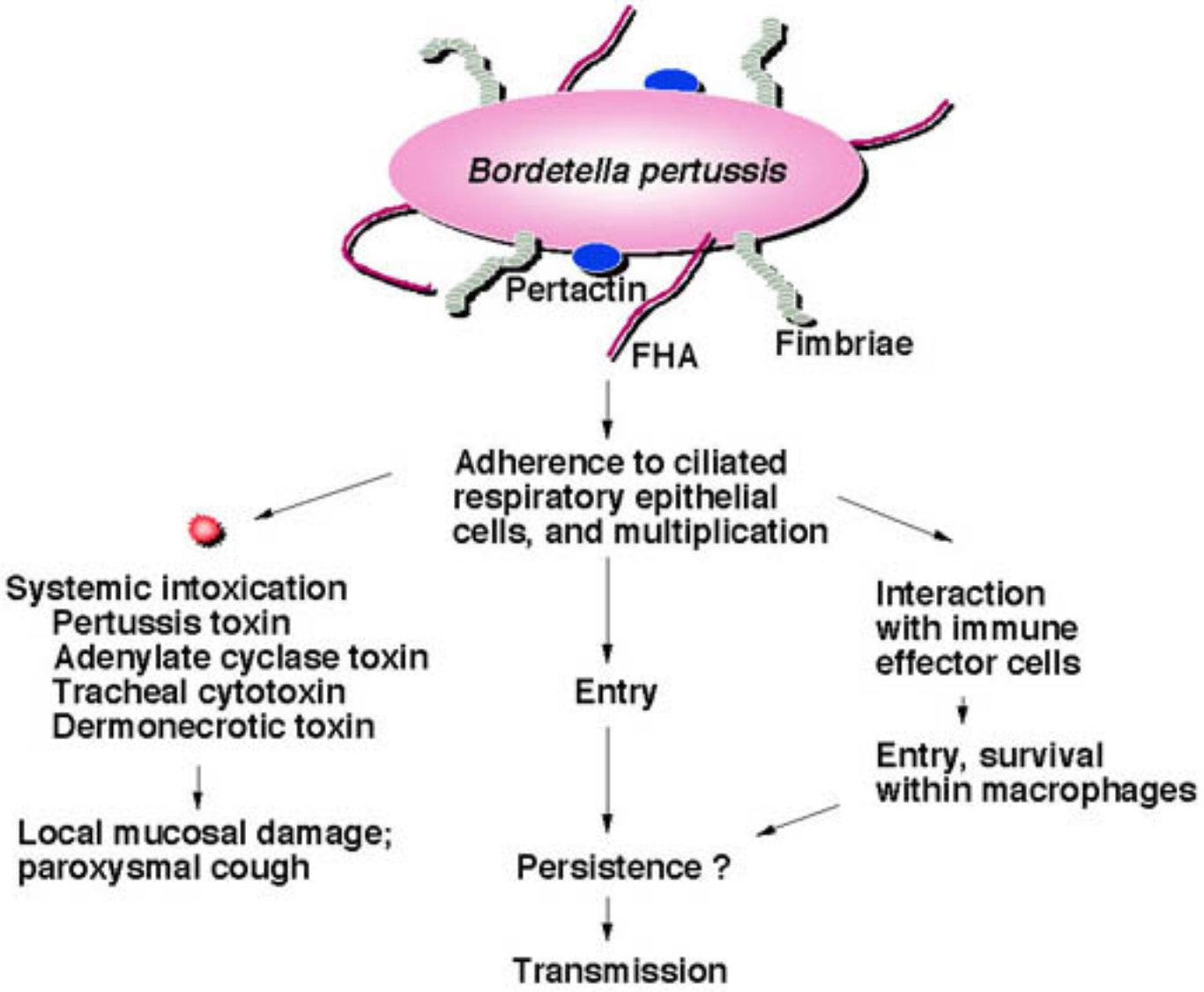
- obligate human parasite
- i/nasal in mice – patchy interstitial pneumonia
- i/cerebral in mice – fatal infection
- infection is limited to respiratory tract ; bacilli are not invasive
- in the initial stages , baciili are limited to nasopharynx, trachea and bronchi.
- as the diseas progresses the infection spreads to the lungs, producing diffuse bronchopneumonia.
- 3 stages- catarrhal, paroxysmal, convalescent

Bordetella Pertussis

Pathogenicity of whooping cough

- onset is insidious, low grade fever, catarrhal symptoms, dry , irritating cough.
- catarrhal stage – stage of maximum infectivity
- as catarrhal stage advances to paroxysmal stage, the cough increases in intensity and comes on in distinctive bouts.
- during the paroxysm , the patient experiences violent spasms of continuous coughing, followed by a long inrush of air into the almost empty lungs, with a characteristics whoop.
- lasts for 6-8 weeks.

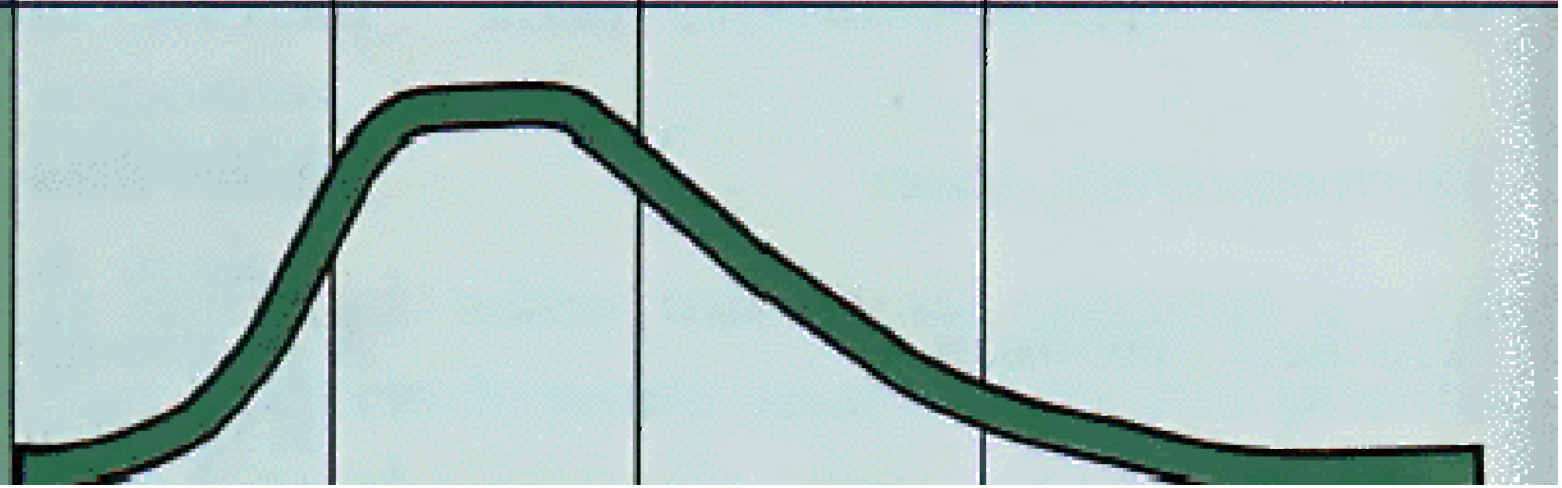
Pathogenesis of *Bordetella pertussis*



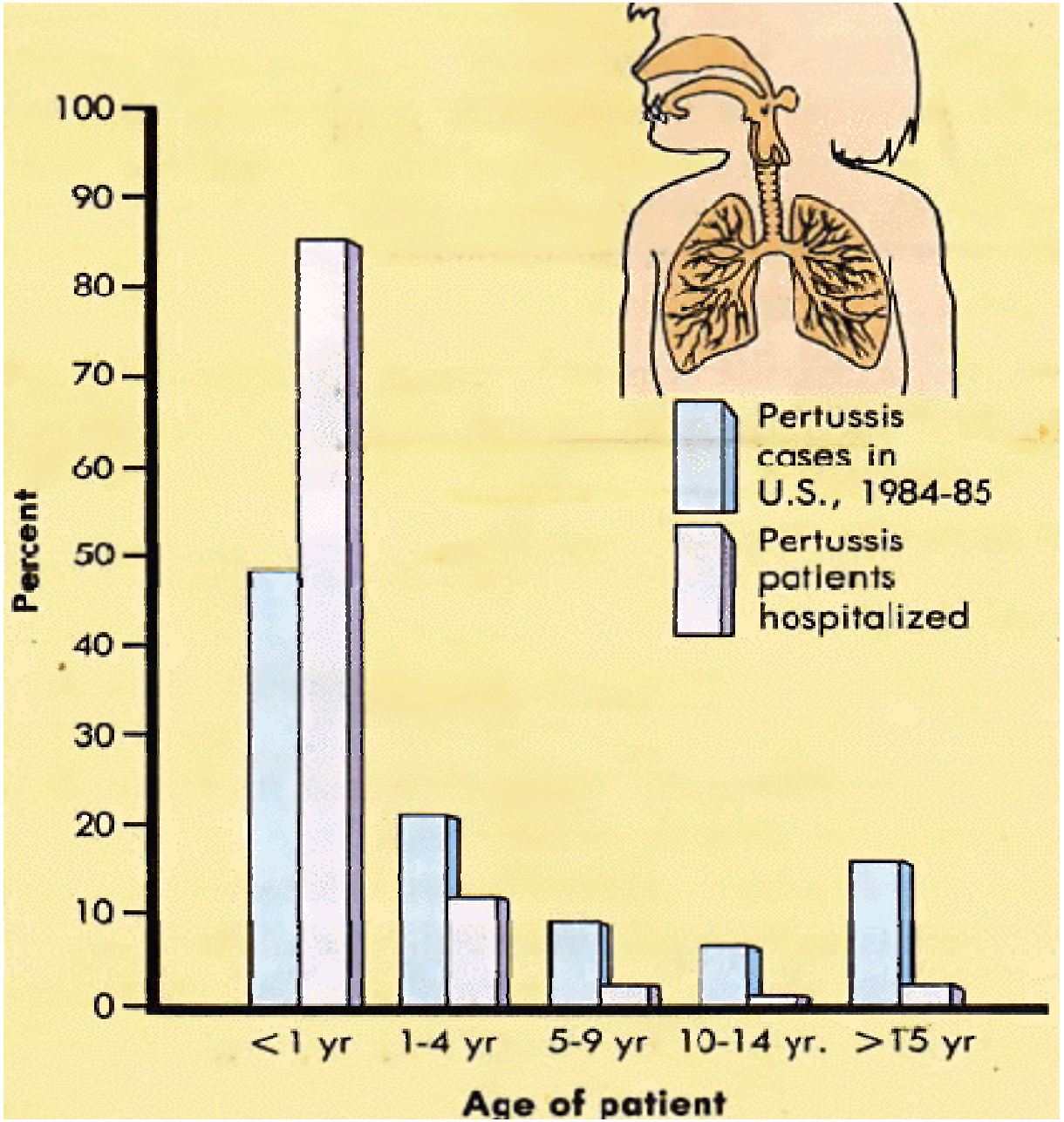
Bordetella Pertussis

Complication

- subconjunctival hemorrhage
- subcutaneous emphysema
- bronchopneumonia
- lung collapse
- convulsions
- coma
- permanent neurological complications- epilepsy, paralysis, retardation, blindness or deafness

	Incubation	Catarrhal	Paroxysmal	Convalescent
Duration	7–10 days	1–2 weeks	2–4 weeks	3–4 weeks (or longer)
Symptoms	None	Rhinorrhea, malaise, fever, sneezing, anorexia	Repetitive cough with whoops, vomiting, leukocytosis	Diminished paroxysmal cough, development of secondary complications (pneumonia, seizures, encephalopathy)
Bacterial culture				

Age Distribution & Severity of Pertussis Cases



Bordetella Pertussis

epidemiology

- whooping cough is predominantly a pediatric disease
- incidence and mortality being highest in first year of life.
- source of infection- patient in early stage of disease
- infection is transmitted by droplets and formites
- one of the most infectious bacterial disease
- secondary attack rate is highest in close house hold contacts.

Bordetella Pertussis

epidemiology

- adults – atypical bronchitis
- natural infection doesn't confer life long protection.
- *B. pertussis* causes 95% of cases, *B. parapertussis* causes 5% of cases ; very infrequently caused by *B. bronchiseptica*.
- Pseudo whooping cough – adenoviruses, Mycoplasma pneumoniae

Bordetella Pertussis

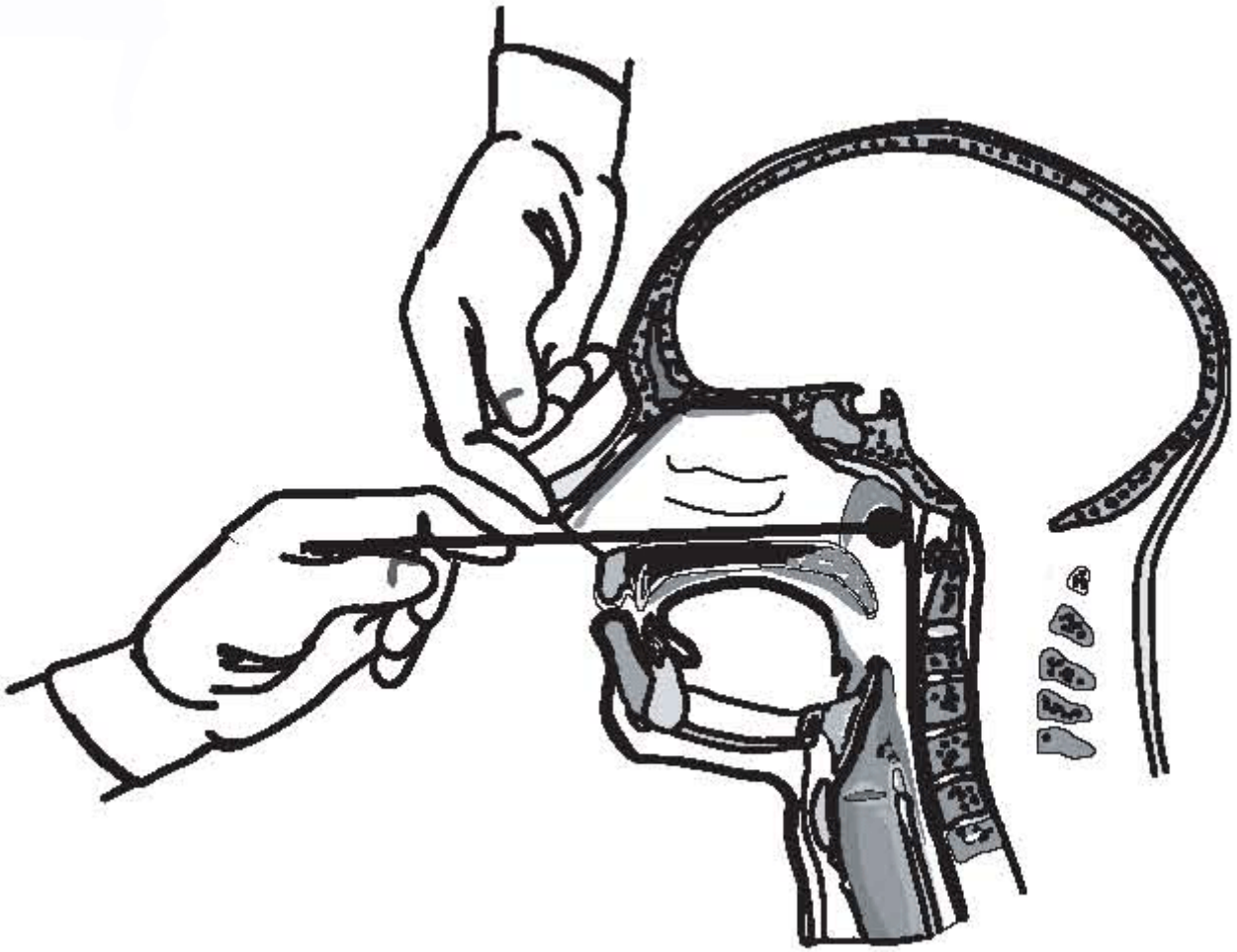
Lab diagnosis

- bacilli present most abundantly in the upper respiratory tract in early stages of diseases.
- in the paroxysmal and convalescent stage the bacilli are not easily demonstrated .
- direct fluorescent Ab technique to detect bacilli in respiratory secretions
- 3 types of techniques for sample collections
    1) cough plate method- here the pate is held 10-15 cms away from the patient's mouth during a bout of violent coughing; advantage that the sample is directly inoculated on the culture plate.

Bordetella Pertussis

Lab diagnosis

- 3 types of techniques for sample collections
  1) cough plate method-
  2) postnasal (peroral) swab- secretions from the posterior pharyngeal wall are collected with a cotton swab on a bent wire passed through the mouth. West post nasal swab.
  3) Pernasal swab- here a swab on a flexible nichrome wire is passed along the floor of the nasal cavity and collected from the pharyngeal wall ; nasopharyngeal aspirate can be collected through a soft catheter attached to a syringe



Bordetella Pertussis

Lab diagnosis

- Dacron or calcium alginate swab are preferred.
- transport immediately
- culture on Bordet Gengou medium or its modification like Lacey's DFP medium- incorporation of diamide fluoride and penicillin.
- colony grow in 48-72 hrs, gram stain , slide agglutination,
- demonstration of secretary Ig A in the nasopharyngeal secretions by ELISA
- PCR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DIAGNOSTICS
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Characteristics	*B. pertussis*	*B. parapertussis*	*B. bronchiseptica*
Oxidase	+	−	+
Urease	−	+	+
Motility	−	−	+
Growth on			
Sheep blood agar	−	+	+
MacConkey agar	−	+/−	+

Bordetella Pertussis

Prophylaxis

- specific immunisation with killed B. pertussis vaccine is found to be effective ; use smooth phase I strain is used for vaccine production ; use of 0.2% merthiolate during several months storage at 4° C has been recommended.
- DPT ; B. pertussis acts an adjuvant for the toxoid producing better antibody response.
- 3 injections at 6,10 ,14 weeks followed by booster at the end of first year of life.
- complication- local soreness, fever, convulsions, encephalopathy, provocation polio; subsequent doses should be omitted.

Bordetella Pertussis

Prophylaxis

- children under 4 years who had contact with patients should receive booster vaccine and erythromycin.
- acelluar pertussis vaccine- contain inactivated pertussis toxin (PT) and may contain one or more other bacterial components (e.g., filamentous hemagglutinin [FHA],pertactin [Pn] or fimbriae