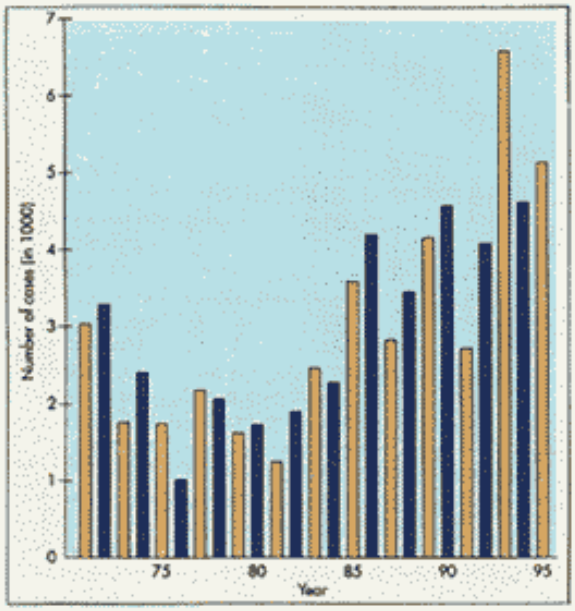


FIGURE 33-1 Incidence of pertussis in the United States from 1971 to 1995. (From *MMWR* 44:525-529, 1995.)

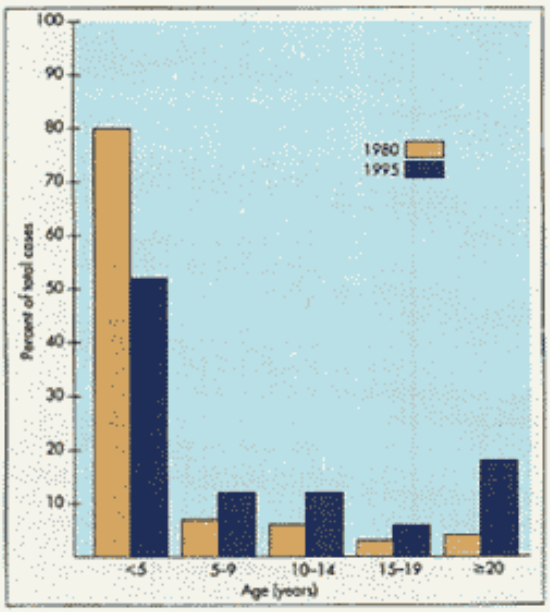


FIGURE 33-2 Age distribution for pertussis infections reported during 1980 and 1994.

15a

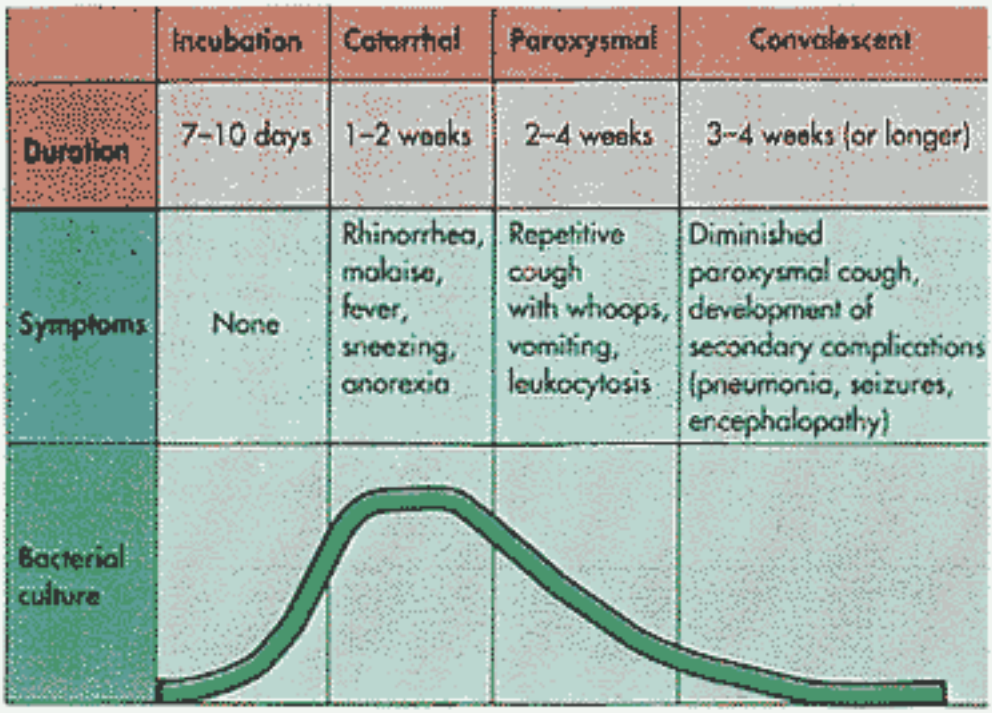
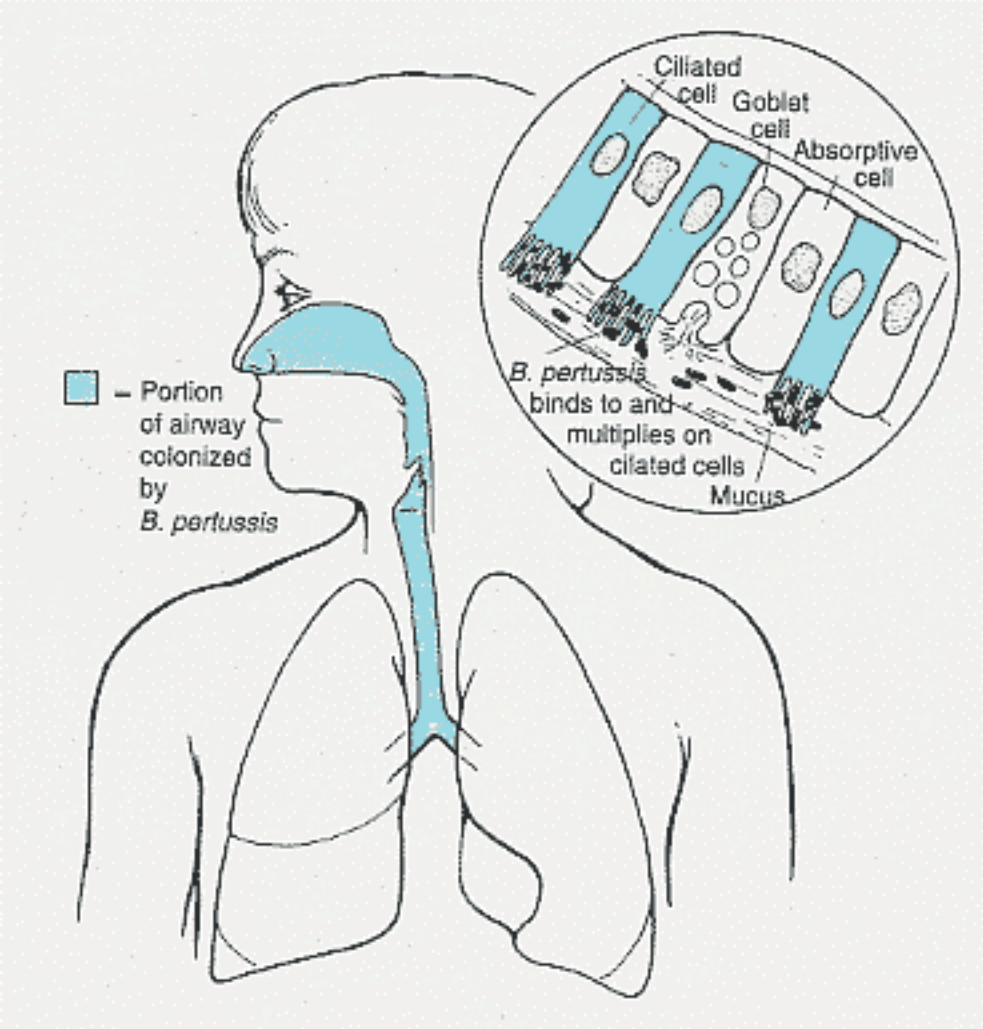


FIGURE 33-3 Clinical presentation of *B. pertussis* disease.

15b

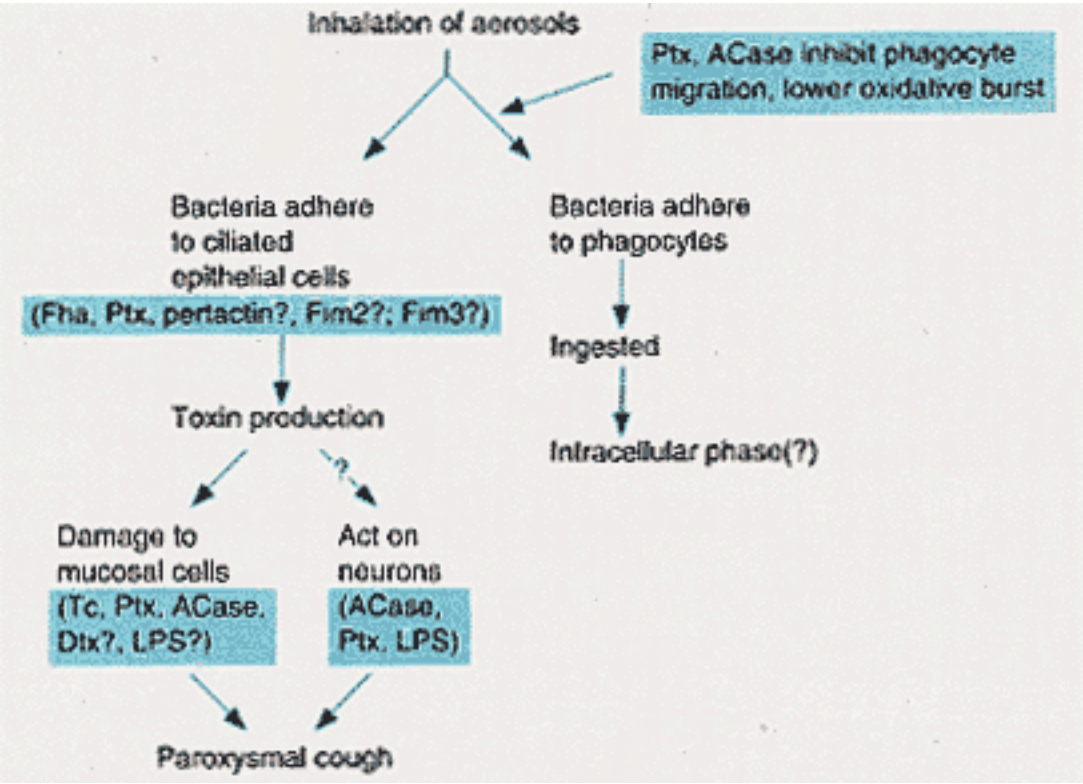


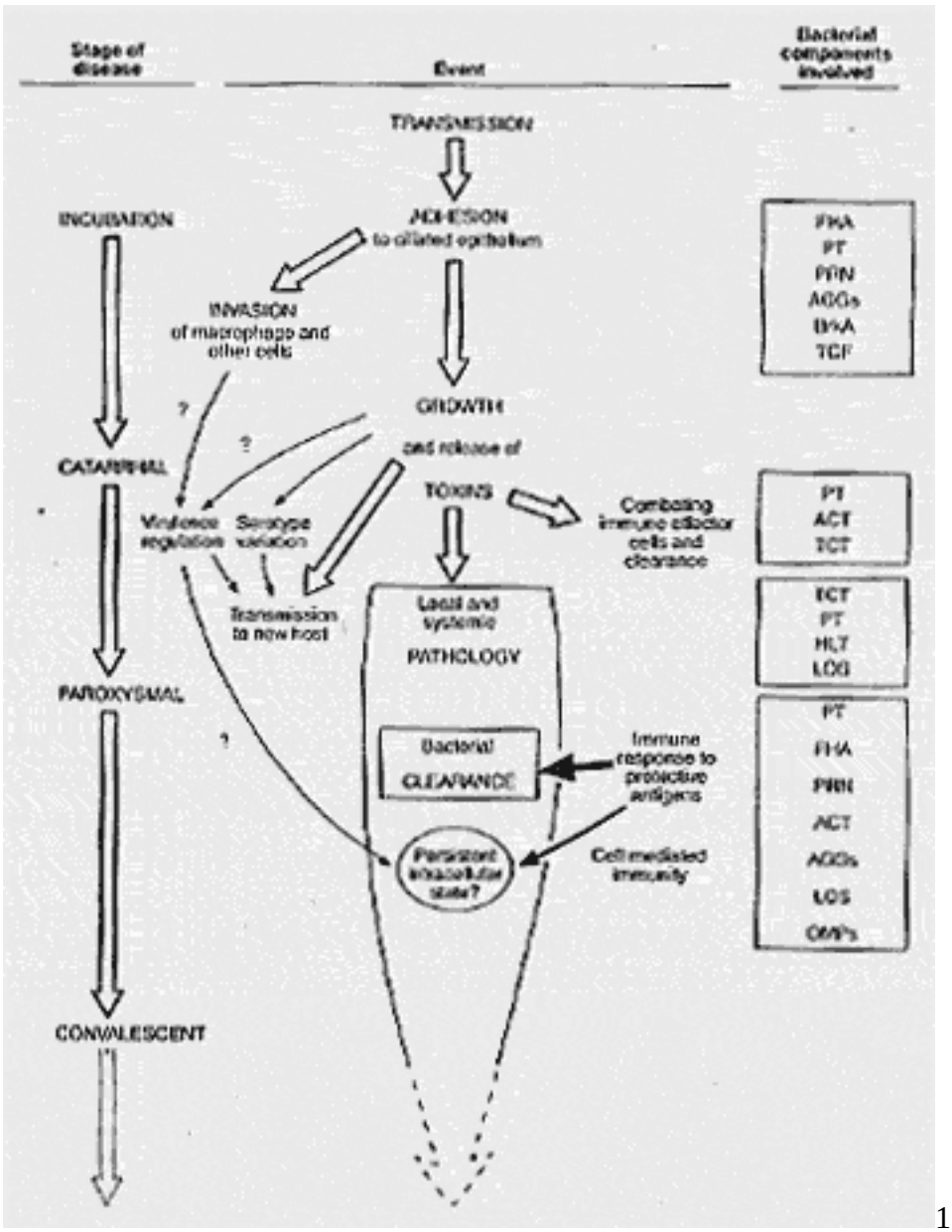
15c

TABLE 33-3 Virulence Factors Associated with *B. pertussis*

VIRULENCE FACTOR	BIOLOGICAL 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 ADP-ribosylates host cell G_i protein, causing deregulation of host cell adenylate cyclase; toxin inhibits phagocytic killing and monocyte migration.
Adenylate cyclase 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.]

15d


Inhalation of aerosols
Ptx, ACase inhibit phagocyte migration, lower oxidative burst
Bacteria adhere to ciliated epithelial cells
(Fha, Ptx, pertactin?, Fim2?; Fim3?)
Bacteria adhere to phagocytes
Ingested
Intracellular phase(?)
Toxin production
?
Damage to mucosal cells
(Tc, Ptx, ACase, Dtx?, LPS?)
Act on neurons
(ACase, Ptx, LPS)
Paroxysmal cough
15e


Stage of disease
Event
Bacterial components involved
TRANSMISSION
INCUBATION
ADHESION
to ciliated epithelium
FHA
PT
PRN
AGGs
BvgA
TCF
INVASION
of macrophage and other cells
GROWTH
and release of
CATARRHAL
TOXINS
PT
ACT
TCT
Virulence regulation
Serotype variation
Combating immune effector cells and clearance
Transmission to new host
Local and systemic
PATHOLOGY
ECT
PT
HLT
LOS
PARoxysmal
Bacterial
CLEARANCE
PT
FHA
PRN
ACT
AGGs
LOS
OMPs
Immune response to protective antigens
Persistent infection/colonization state?
Cell mediated immunity
CONVALESCENT
15f

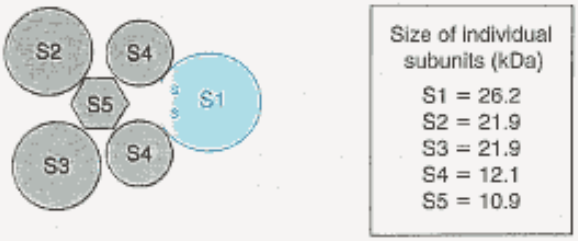


Figure 13-3 Structure of pertussis toxin. S1 is the ADP-ribosylating subunit. S2 to S5 form the binding portion of the toxin.

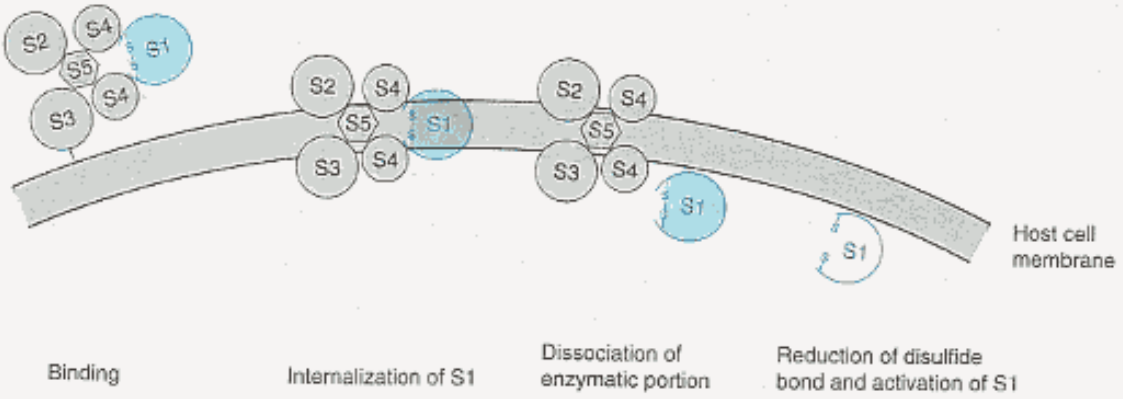


Figure 13-5 Hypothetical steps involved in the binding, internalization, and activation of pertussis toxin.

15g

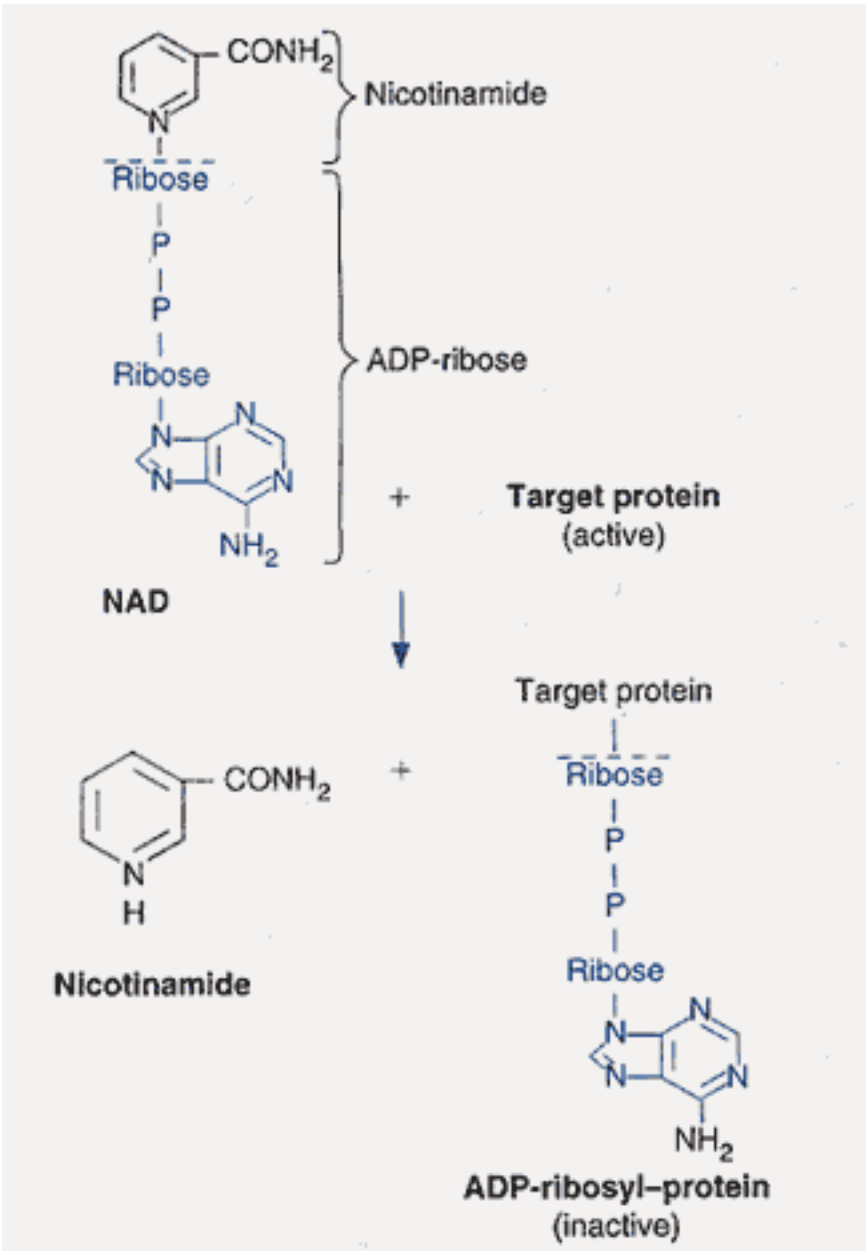


Figure 4-2 ADP-ribosylation of a target host protein. The ADP-ribosyl group is removed from NAD (dashed line) and covalently attached to a host cell target protein.

15h

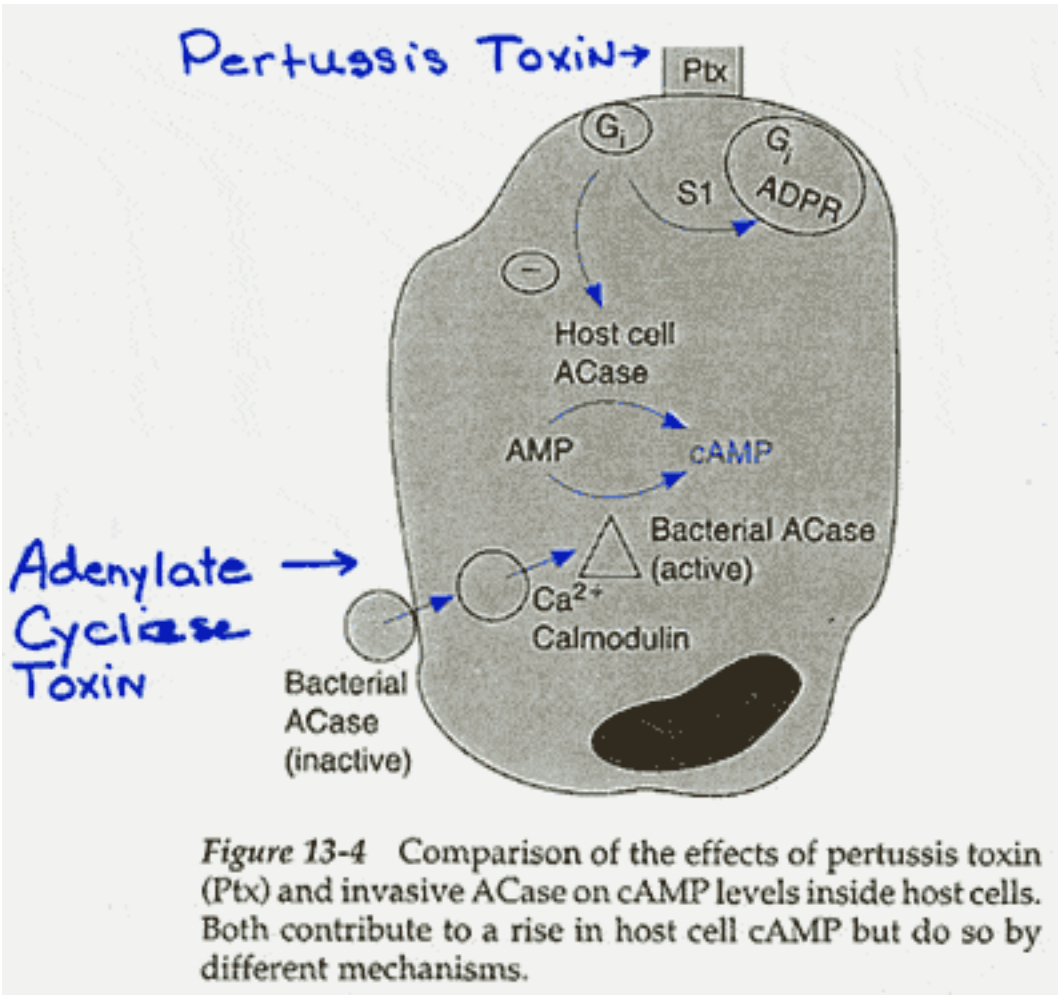


Figure 13-4 Comparison of the effects of pertussis toxin (Ptx) and invasive ACase on cAMP levels inside host cells. Both contribute to a rise in host cell cAMP but do so by different mechanisms.

15i

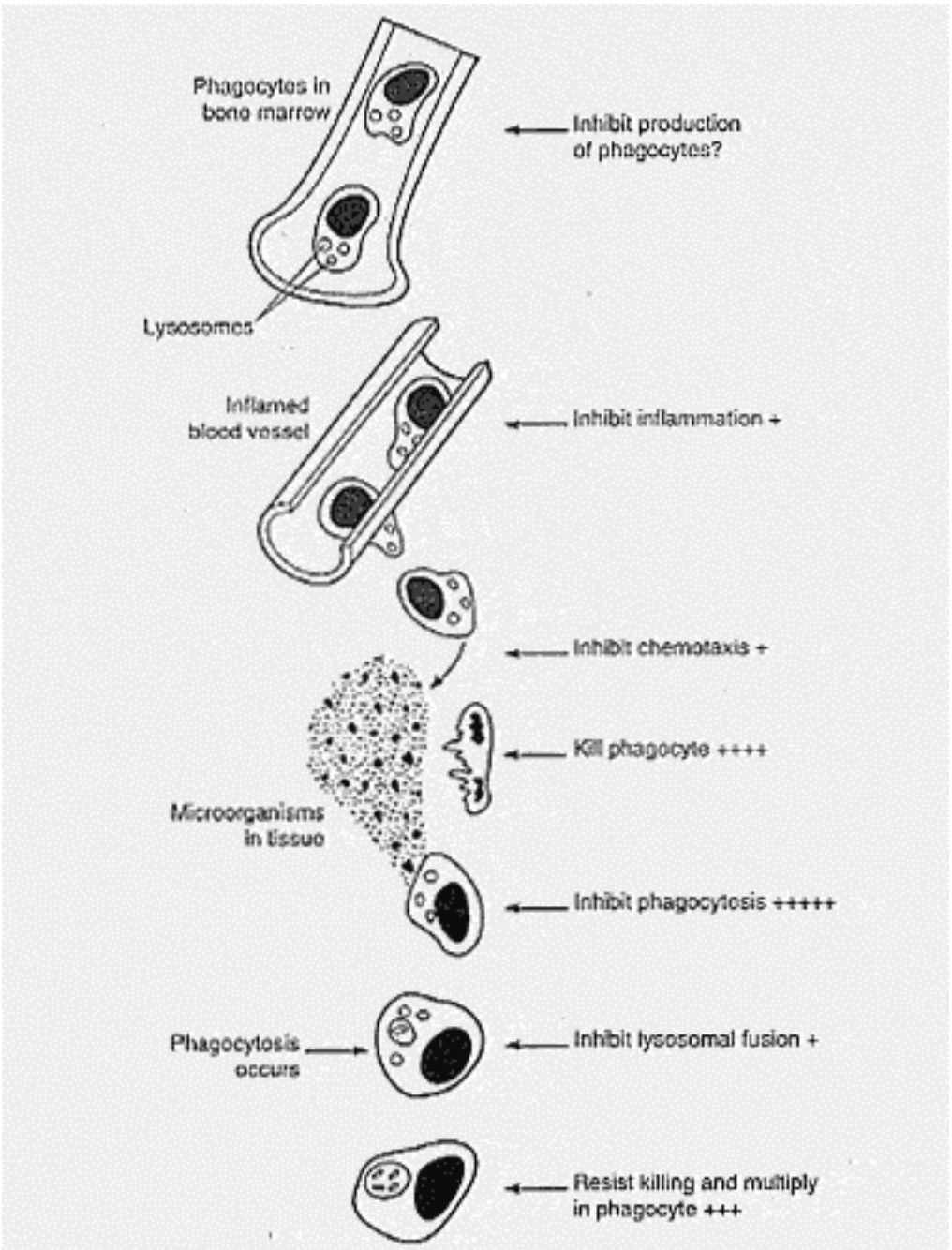


Fig. 4.5 Antiphagocytic strategies available to microorganisms. Extent to which strategies are actually used by microorganisms are indicated by plusses.

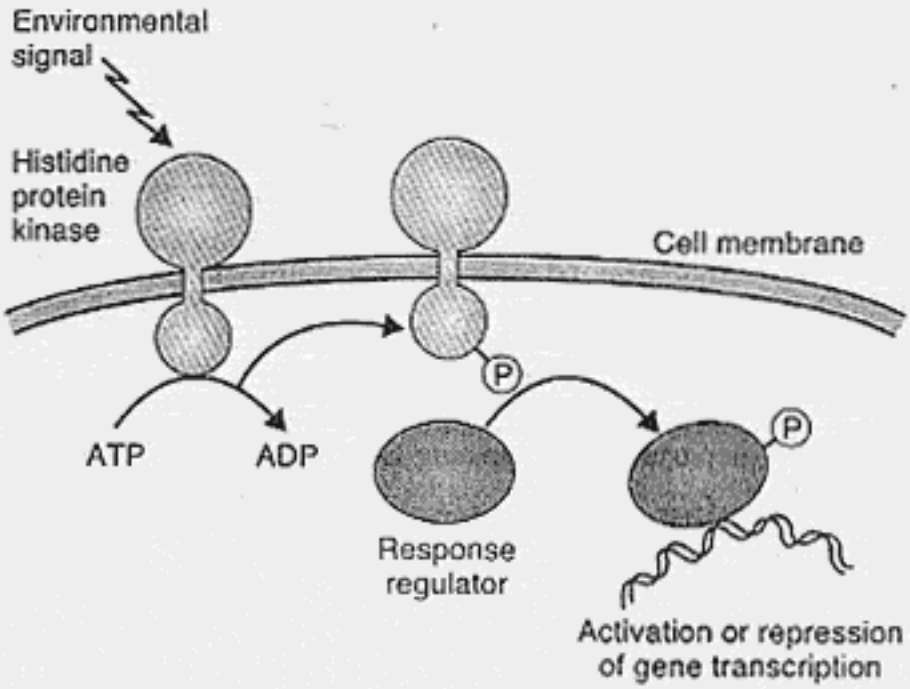


Figure 19.3. The two-component regulatory system for signal transduction. The sensor/transmitter is activated by a signal to become an active protein kinase capable of phosphorylating a response regulator. In the phosphorylated form, the regulator protein acts on DNA to either allow or prevent the expression of a specific set of genes.

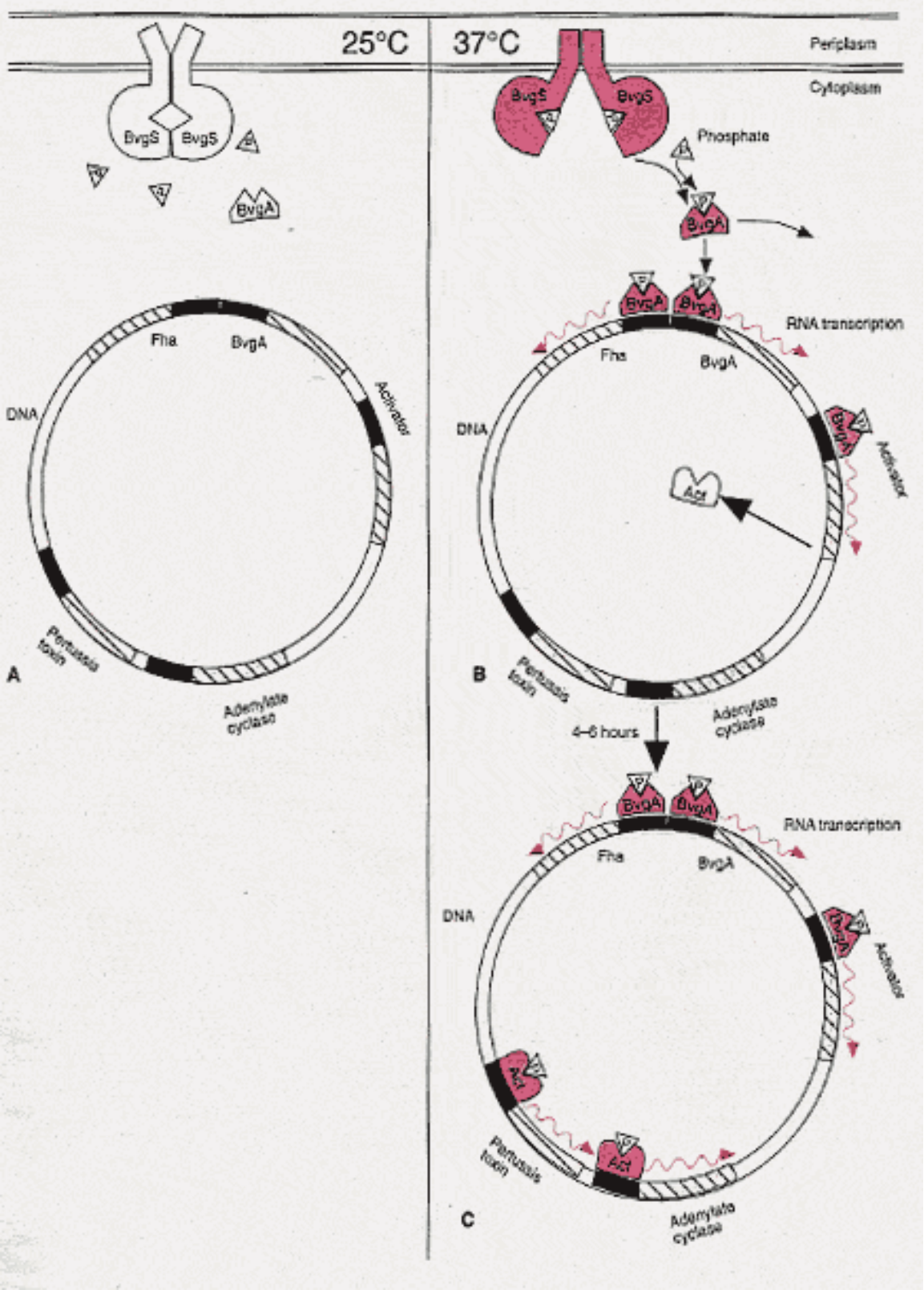
15k

Table 1. Virulence factors of *B. pertussis*

Factor	Putative function(s)	Component in licensed acellular vaccine(s)
bvg[a] regulated		
Filamentous hemagglutinin (FHA)	Adhesin	Yes
Pertactin (PRN)	Adhesin	Yes
Fimbriae (FIM)	Adhesin	Yes
Tracheal colonization factor	Possible adhesin	No
Pertussis toxin (PT)	Toxin, possible adhesin	Yes
Adenylate cyclase toxin (ACT)	Inhibition of phagocytes	No
bvg[a] independent		
Tracheal cytotoxin (TCT)	Ciliostasis and respiratory cell death	No

[a]*bvg*, bordetella virulence genes.

15l


25°C
37°C
Periplasm
Cytoplasm
BvgS
BvgS
BvgA
Phosphate
P
BvgA
BvgA
BvgA
RNA transcription
Fha
BvgA
DNA
Activator
Act
Pertussis toxin
Adenylate cyclase
A
B
4–6 hours
C

15m