Virulence factors

Microbiology PG Sem 4

Paper 10: Unit IV

Microbiology – Chapter 13

Virulence factors

Virulence factors – factors that aid or enhances the microbes ability to invade and spread within the host (know for test) Ex. List the categories of "virulence" factors in microbes; explain each category, and give an example of a disease causing agent for each category.

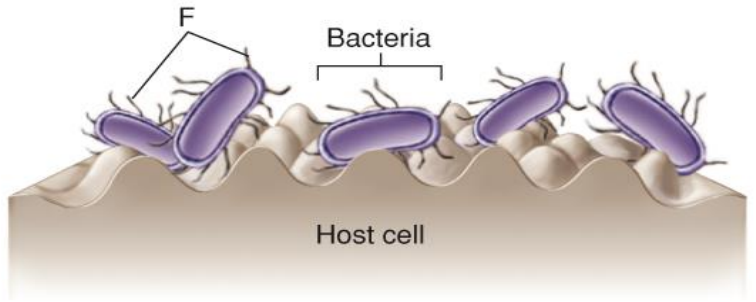
Adherence: In order for a microbe to cause disease it first must adhere to a host surface. Some microbes produce materials or structures that allow them to adhere (stick) to membranes or surfaces, and thus escape defenses

Pili (fimbriae) – *Neisseria gonorrhea*, if a strain has no pili it is not pathogenic. The chemicals that allow such attachment are called "**adhesins**" – They are often glycoproteins or protein that bind to receptors on host cell surfaces.

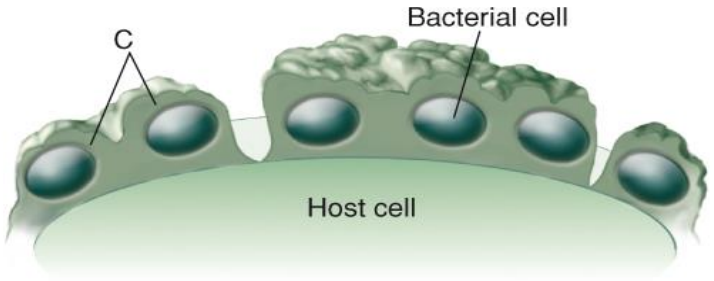
Glycocalyx – The capsule again is a tightly bound polyscaccharide material on the outside of certain bacterial cells (part of a bacterial envelope). Streptococcus pneumoniae is good example. Virulent strains are encapsulated; non-virulent strains are not. Recall the classic "Griffith experiment" from chapter 9? Transformation?

Spikes – Viral envelopes of some viruses, Influenza a, H5N1

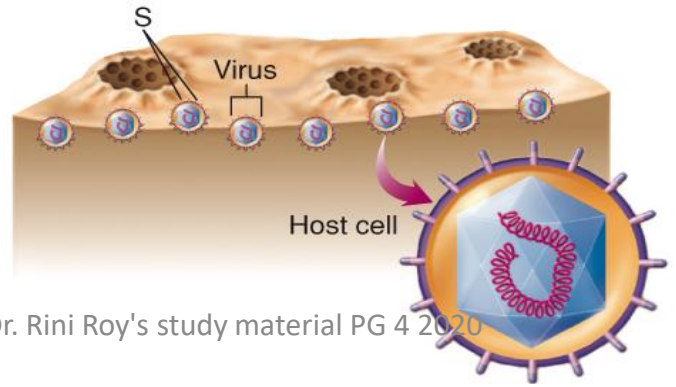
Fig. 13.4



(a) **Fimbriae**



(b) **Capsules**



(c) **Spikes**

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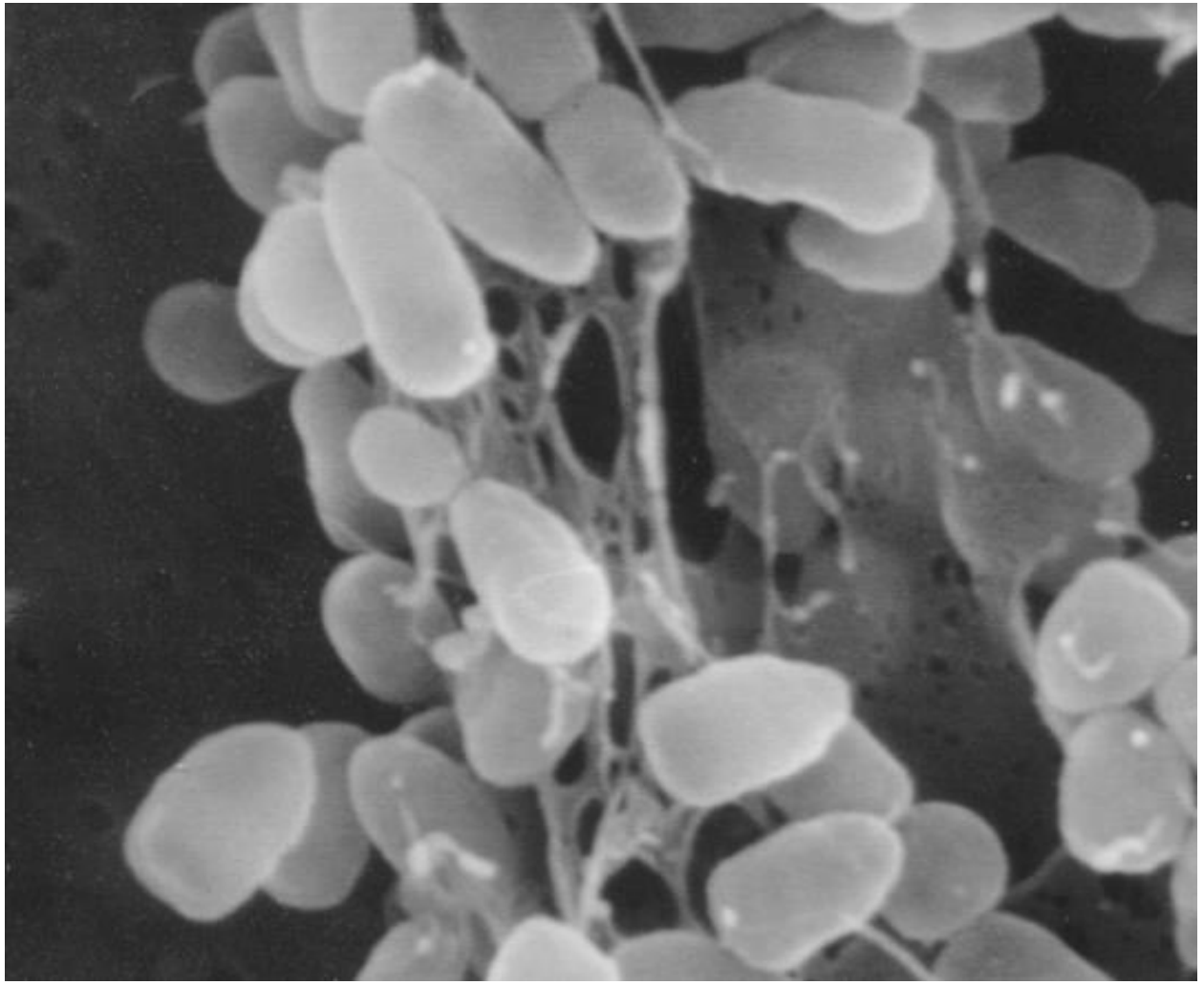
Other adhesions

N. menigitidis (bacterial meningitis agent) produces **protein a**, a surface adhesion on the pili

Mycoplasma pneumonia (atypical bacterial pneumonia) has a surface adhesion that binds to receptor on mucus membrane lining of the respiratory tract

Other Adhesions

SEM of Pseudomonas, Gram (-)



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Toxins – Poisonous microbial bypoducts that are produced by the microbe and diffuse into tissues causing damage/ enhance invasion/ avoid defenses

Exotoxins – excreted outside of cell, both Gram+ and Gram – bacteria produce some of these highly destructive proteins.

Staphylococcus aureus - Staph exotoxin that causes FBI

Another causes "SSSS" Staph Scalded Skin Syndrome (exfoliate)

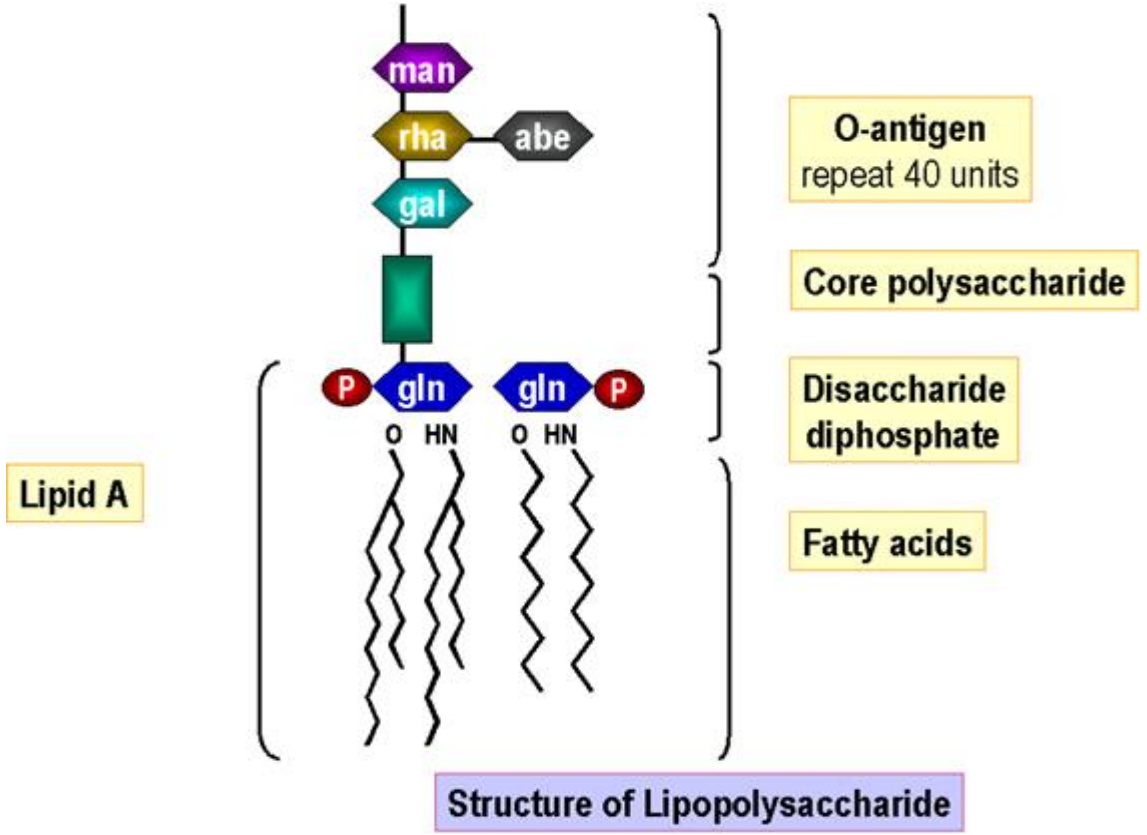
C. botulinum – most powerful neurotoxin, - a taste can kill you

Streptococcus pyogenes - has several tissue destroying toxins; Necrotoxin of flesh eating Strep would be a good example.

Endotoxin – Released by many Gram (-) bacteria when cells lyse, Examples:

Lipid A, **lps** in many pathogenic enteric bacteria like Shigella, can cause high fevers and even shock.

- Endotoxin - Lipid A – raises fever, and shock in Gram (-) pathogens



Endotoxin - Lipid A – raises fever, and shock in Gram (-) pathogens

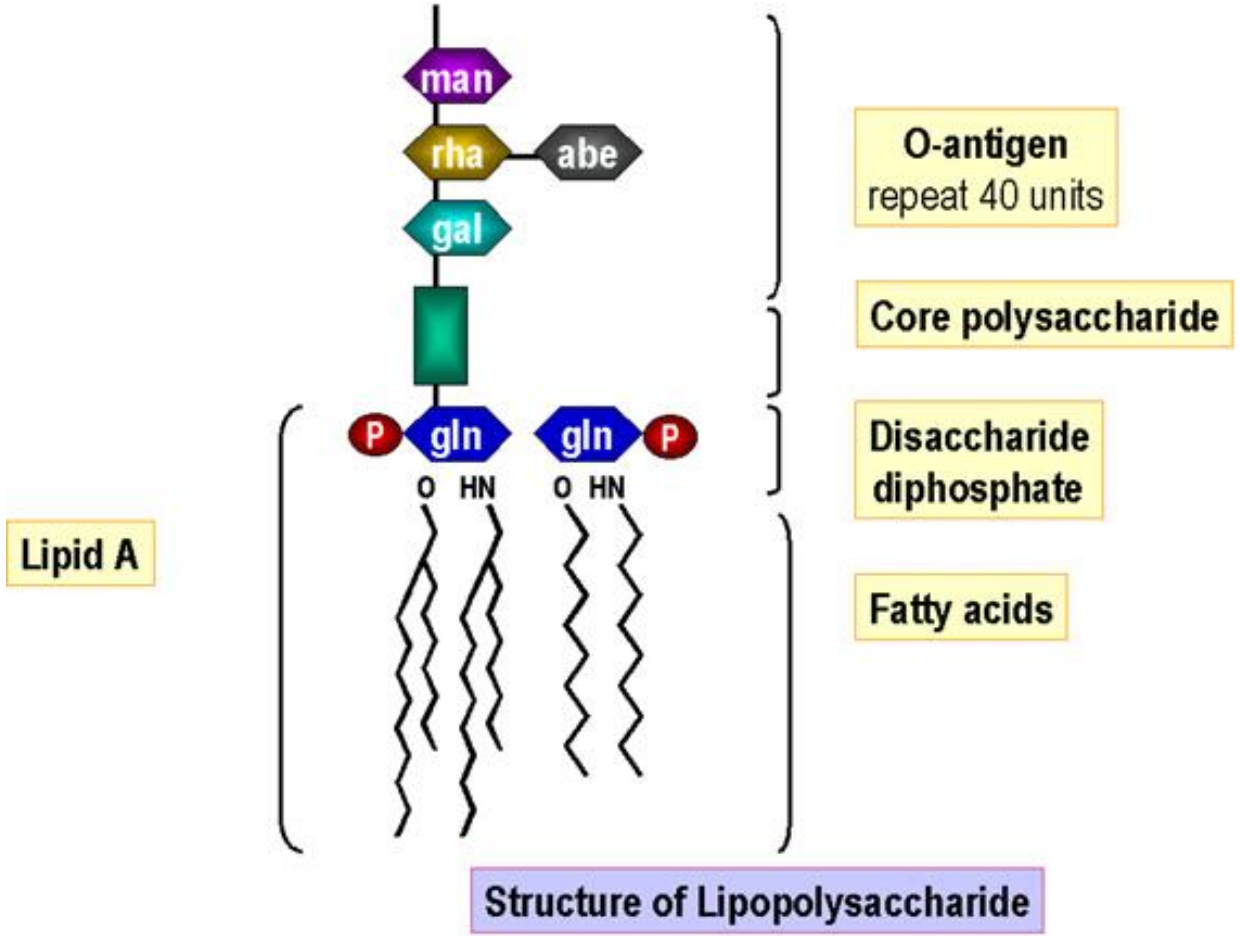
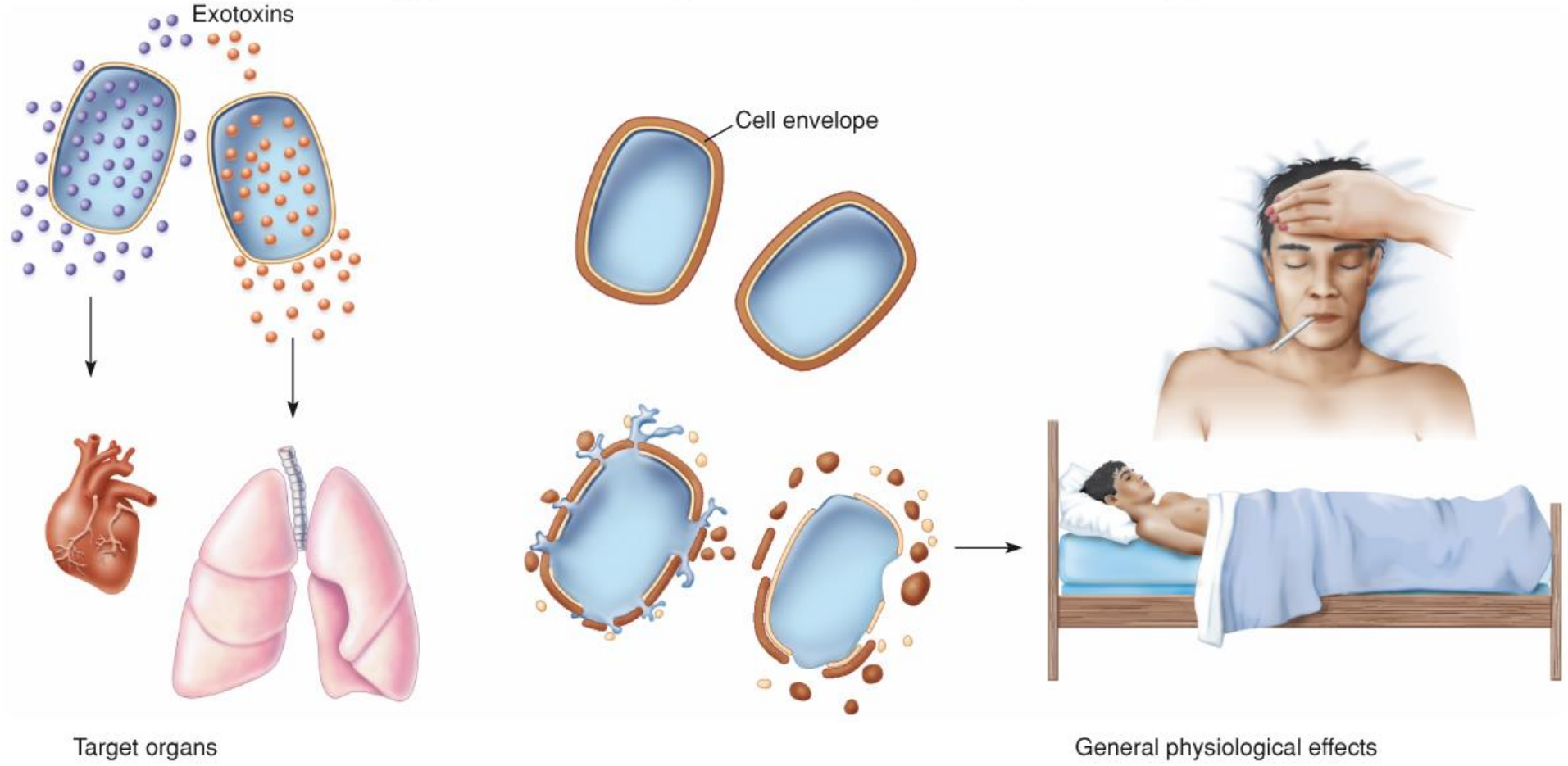


Fig. 13.6



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Enzymes that help invasion

Collagenase – breaks down collagen, the protein holding cells together, thus allows spreading. Clostridia that invade tissue can produce these proteases to digest connective tissue elements (C. perfringens)

Hyaluronidase – breaks down hyaluronic acid, the polysachharide that may hold some cells together, S. pyogenes produces such an enzyme

Causes necrosis and blackening of tissue (inches of progression in hours)

Coagulase – Affects the fibrin in blood causing it to clot, Staph aureus produces one and maybe prevents phagocytosis.

Hemolysin – This exotoxin is an enzyme and lyses RBC. S. pyogenes

Alpha and Beta Hemolysis of the Strep.

- Enzymes: Collagenase, Hyaluronidase

- Enzymes: Hemolysin – lyse RBC

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Evading defenses – Once in tissue some organisms can "evade" the natural defense of a host.

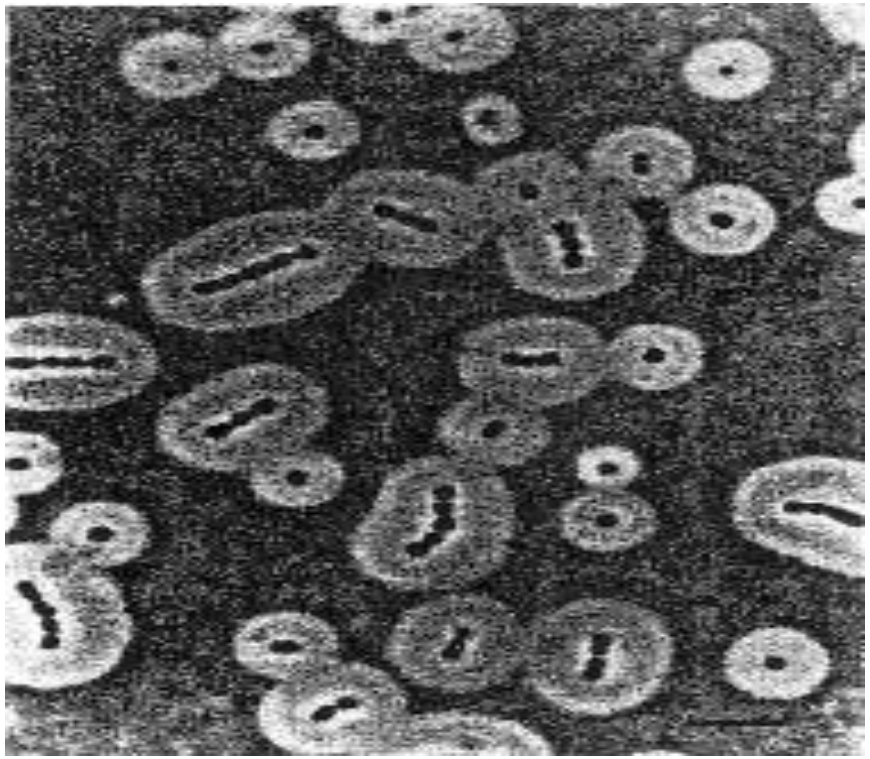
Capsule – Phagocytes can't engulf the pathogen – S. pneumoniae

Surface proteins – Proteins prevent phagocytosis (leukostatin, leukocydins of Staph and Strep)

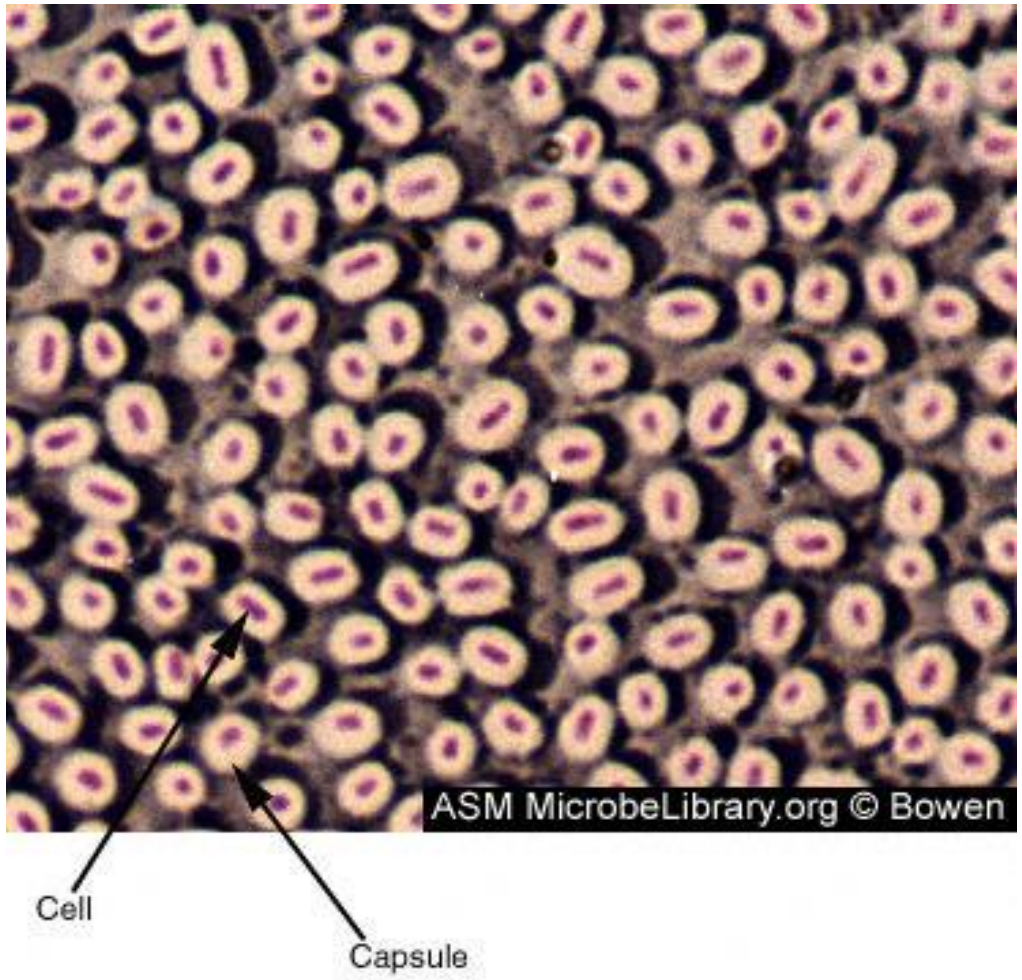
Survive inside phagocyte – Get a free ride and spread (Tubercle bacillus, Listeria bacillus, and others)

Evade immune response - Genetic variability occurs and the result is that antibodies lose effectiveness quickly – genetic shift/drift of the antigenic nature of the Influenza A virus, (FDA today is meeting to SWAG for next years vaccine)

- Evade defenses: Capsule – resisting phagocytosis, Strep.

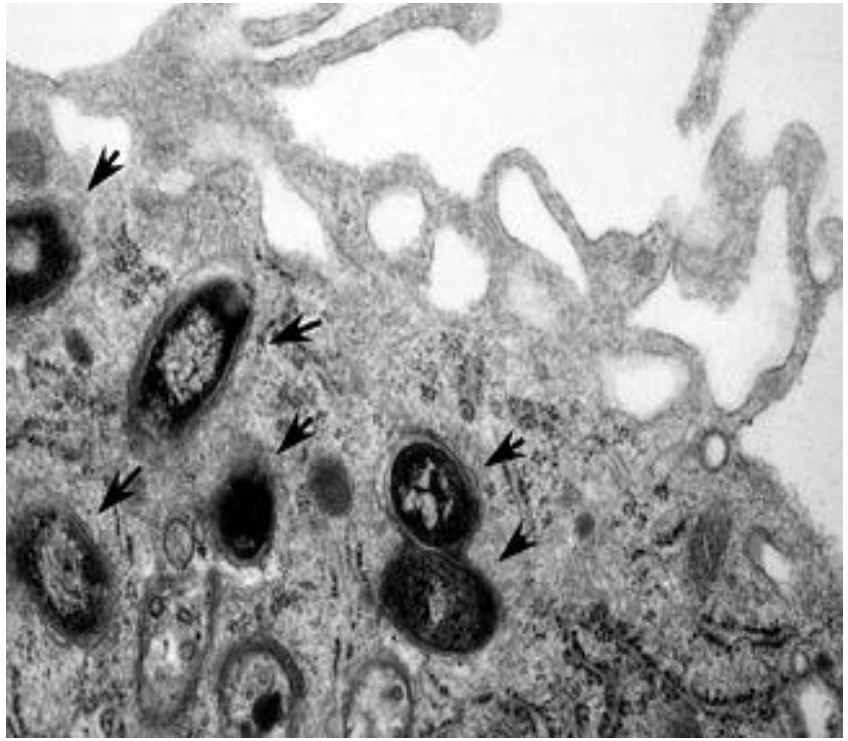


- Adherence: Glycocalyx (capsule)



- **Surface proteins** : Leukocydin, S. aureus
- (MRSA) – Attacks WBC'S

M. tuberculosis inside lung macrophage



- **Survive inside phagocyte, tubercle bacillus**
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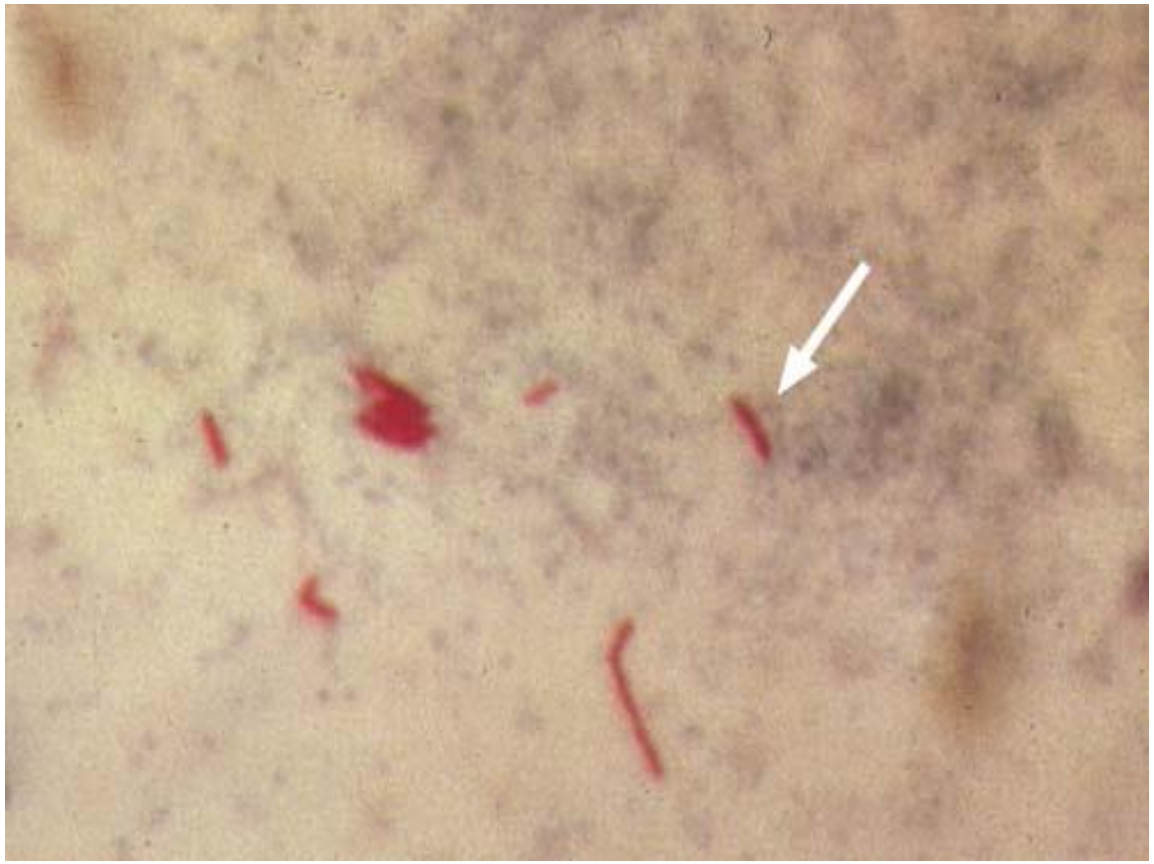
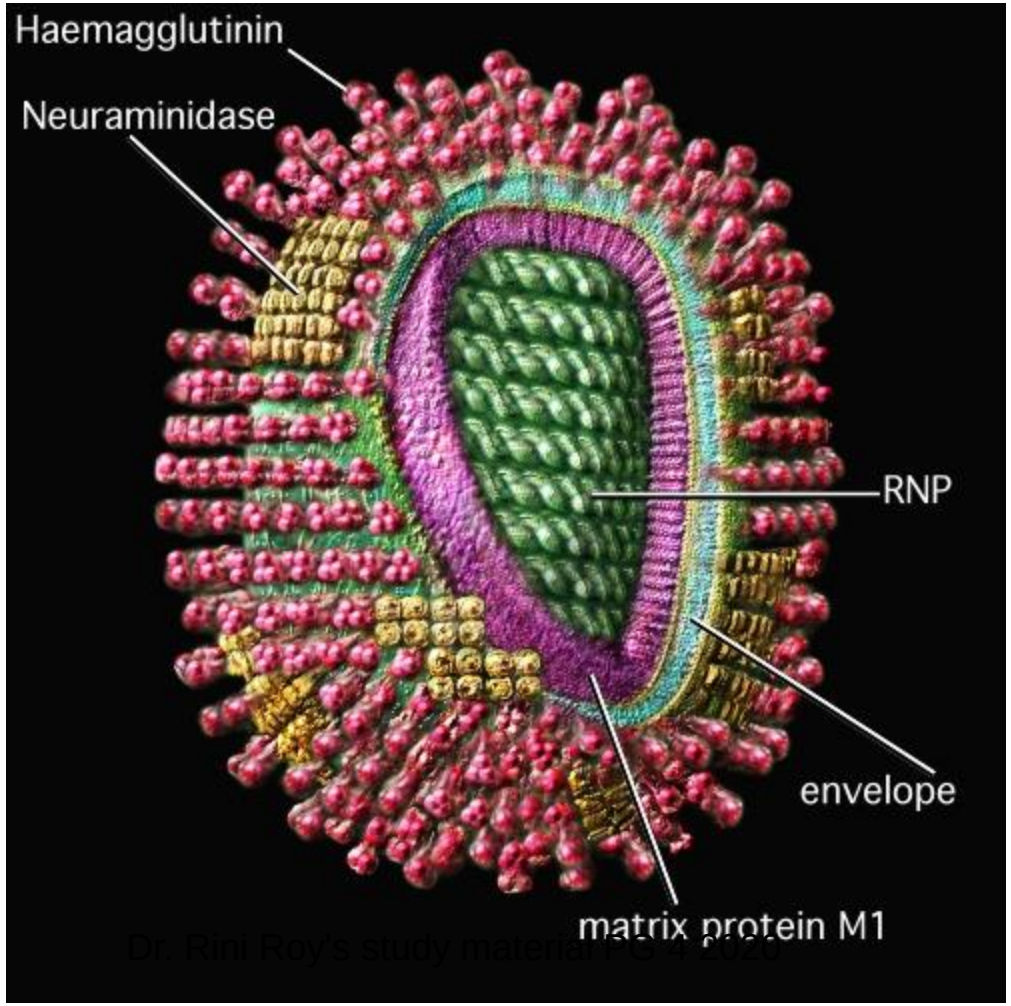


Evading immune response

- Influenza



- **Evade immune response : Influenza A**
- **H5N1 – “Bird Flu”**
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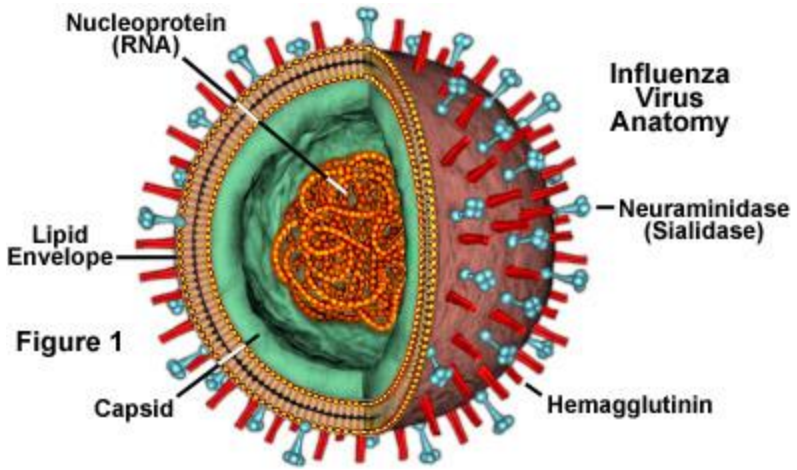

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Iron binding – Iron is tightly bound in our bodies and microbes need it to grow,

Those organisms that can acquire it have and advantage and can spread faster;

more virulent – Cholera is an example, HIB (H. influenza B)