



# **Introduction to Enterobacteriaceae**

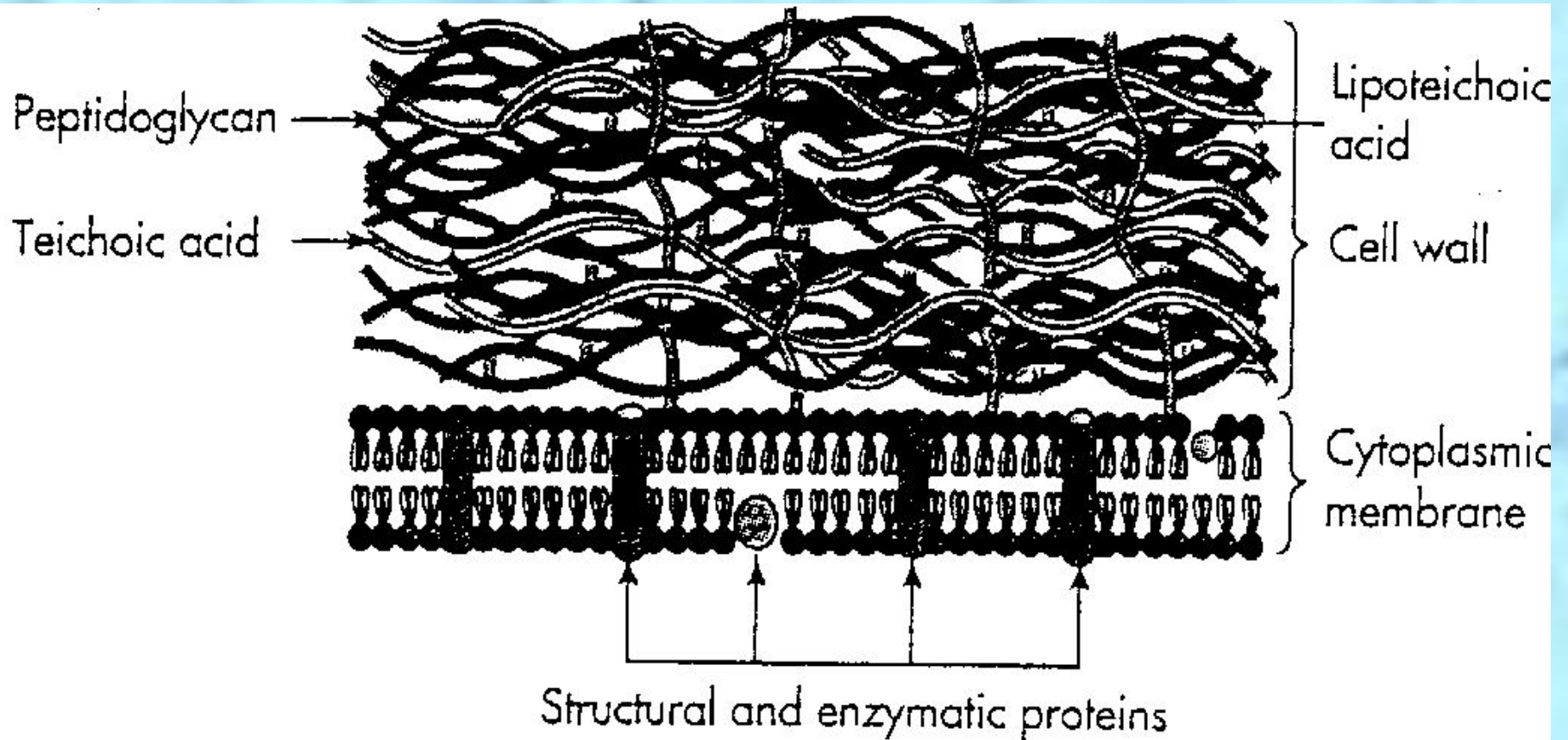
# Enterobacteriaceae

- Small **gram-negative rods** (2-5 by 0.5 microns)
- Most motile with **peritrichous flagella**
  - *Shigella* and *Klebsiella* are nonmotile
- **Oxidase-negative facultative anaerobes**
- **Reduce nitrate**
- **Ferment glucose** and other carbohydrates
- Many genera
  - *Escherichia*, *Salmonella*, *Shigella*, *Klebsiella*, *Proteus*, *Enterobacter*, *Yersinia*, etc.
- Some strains **opportunistic** pathogens
- Some strains **true pathogens**
  - *Salmonella*, *Shigella*, *Yersinia*, some strains of *E. coli*

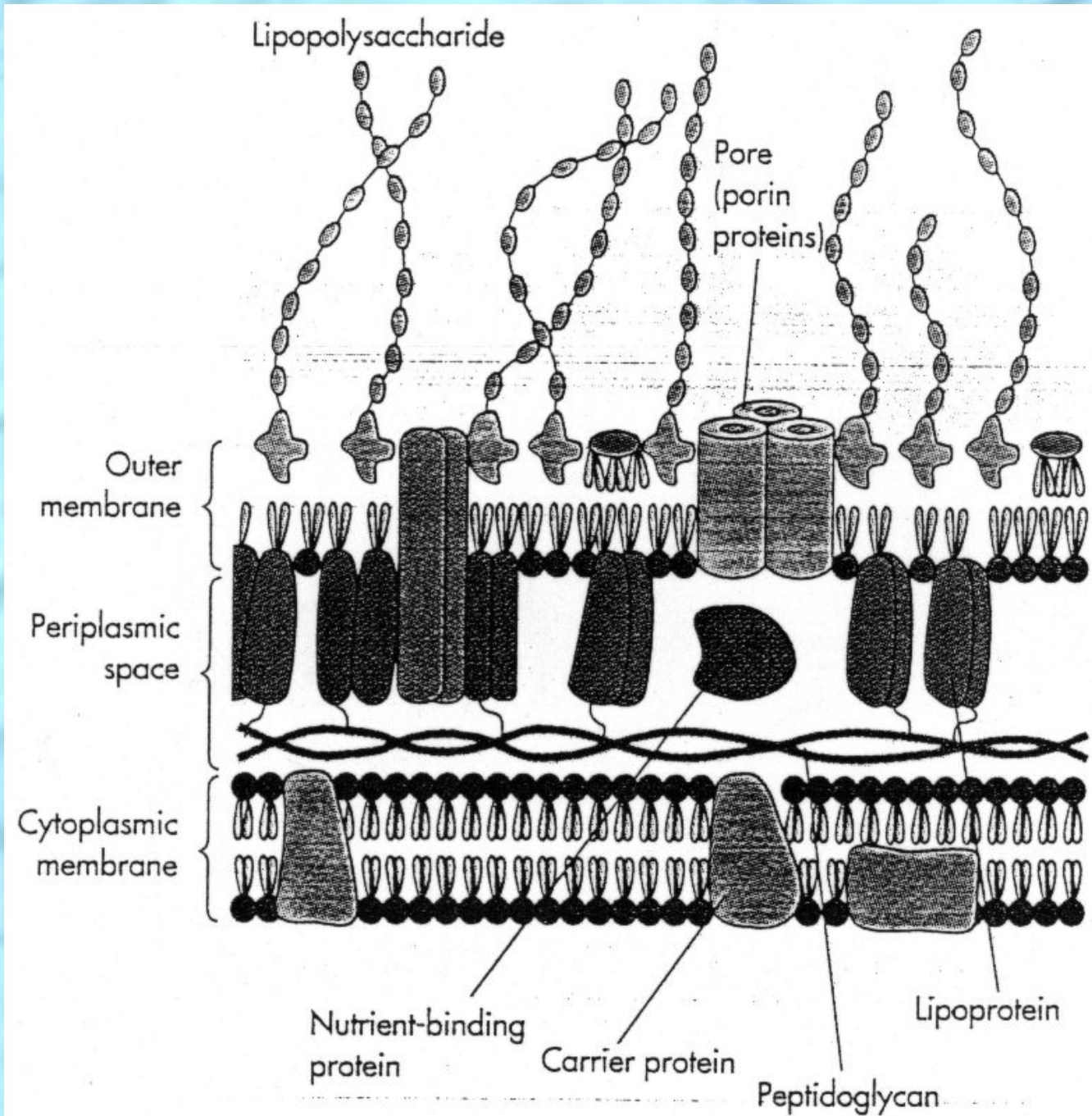
# ***Distinguishing Properties Associated with All Enterobacteriaceae:***

- Ferment glucose**
- Reduce nitrates**
  - $\text{NO}_3$  to  $\text{NO}_2$  or all the way to  $\text{N}_2$
- Oxidase negative**

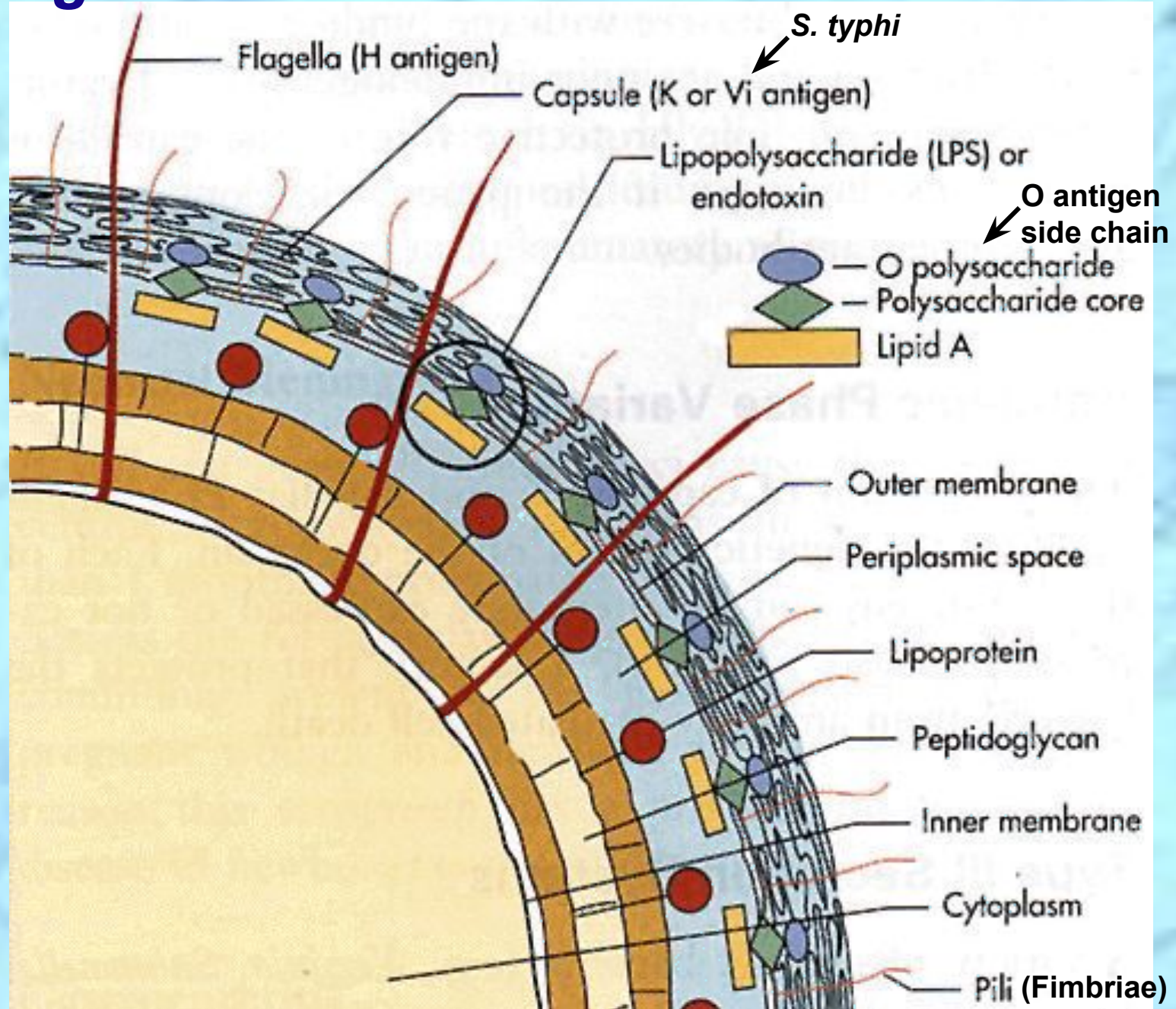
# Gram-Positive Cell Wall

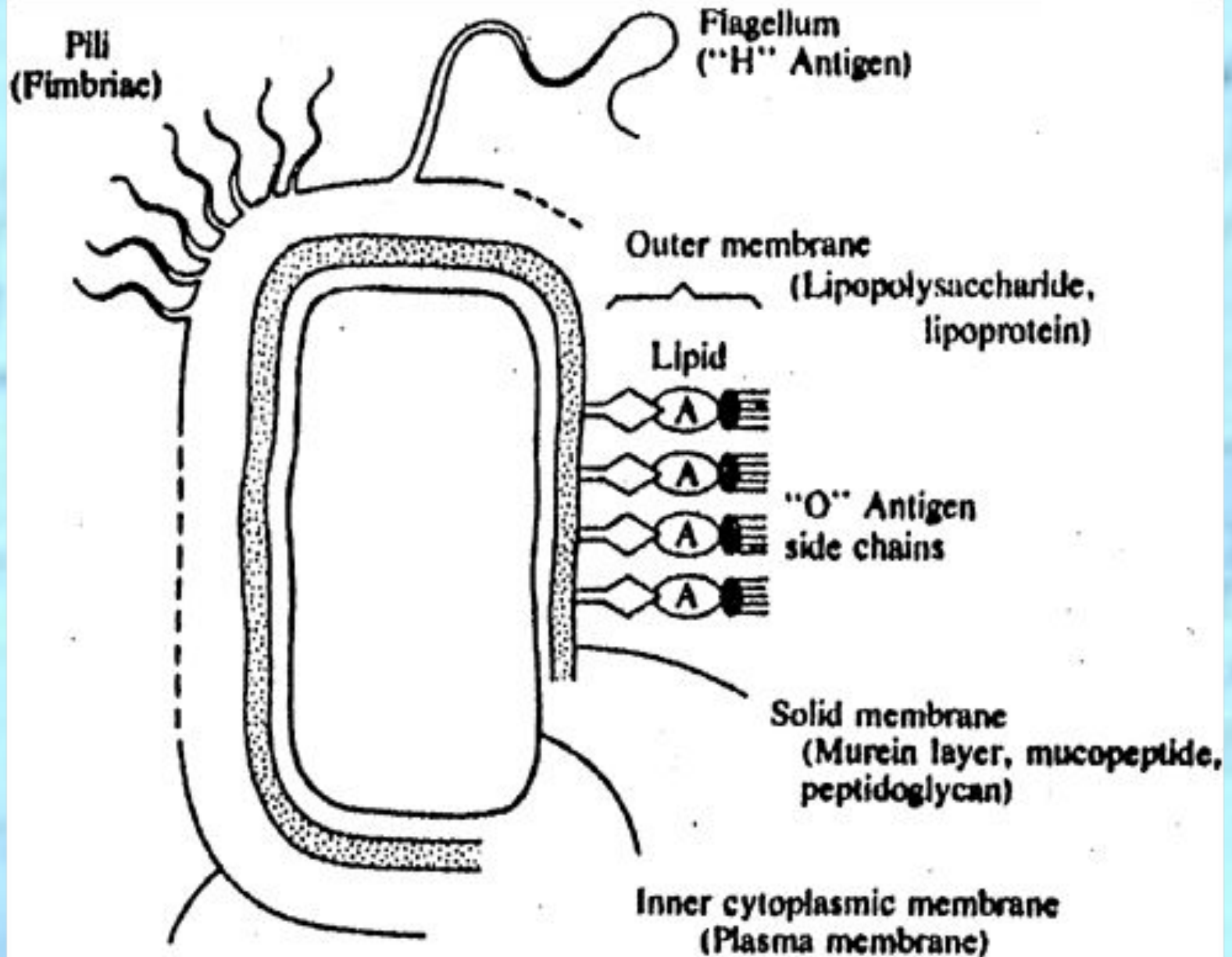


# Gram-Negative Cell Wall



# Antigenic Structure of Enterobacteriaceae

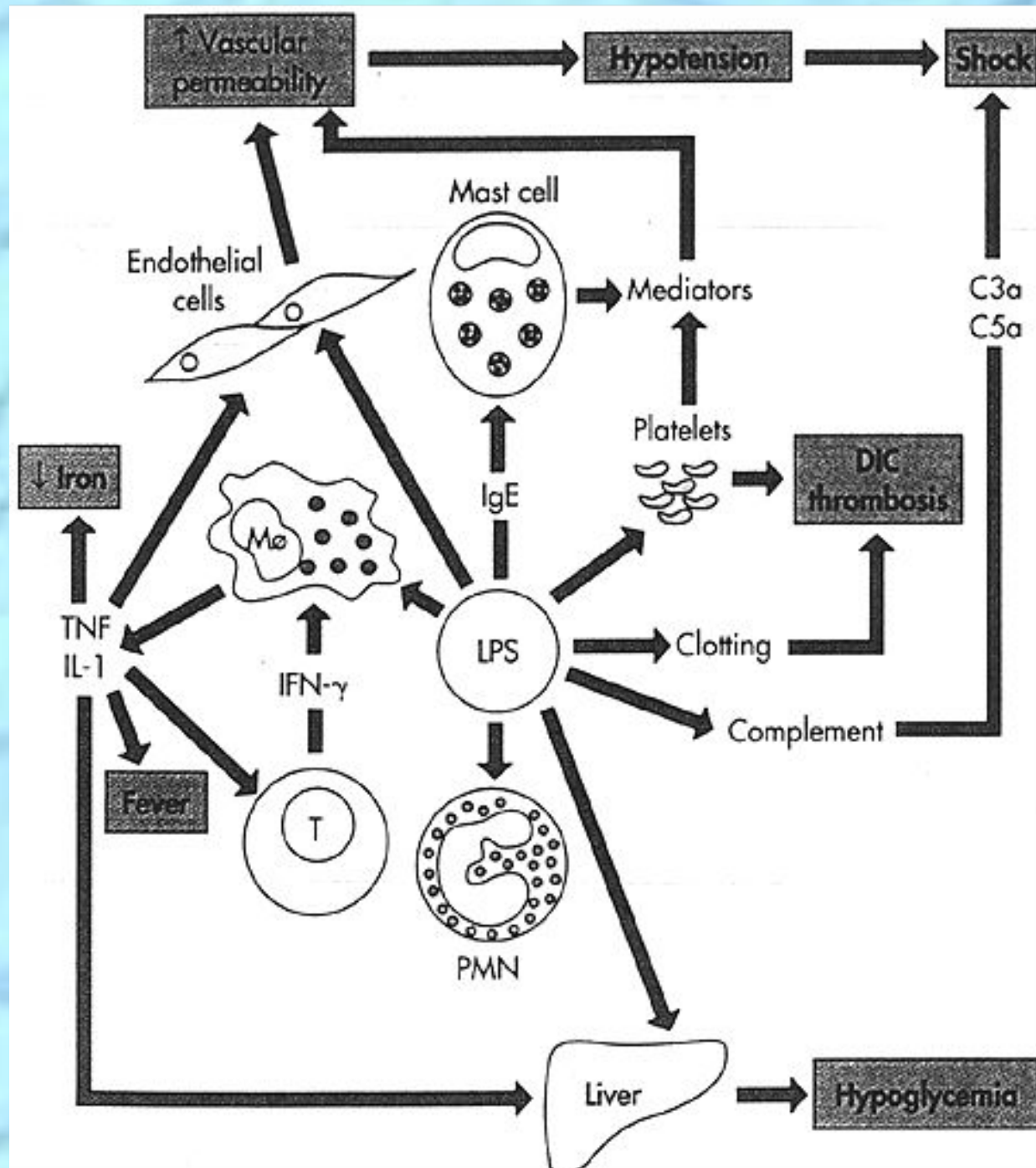




**Capsule:** "K" Antigen of *E. coli*  
 "VI" Antigen of *S. typhi*  
 Serotype antigen of *K. pneumoniae*



# Diversity of Activities Associated with LPS



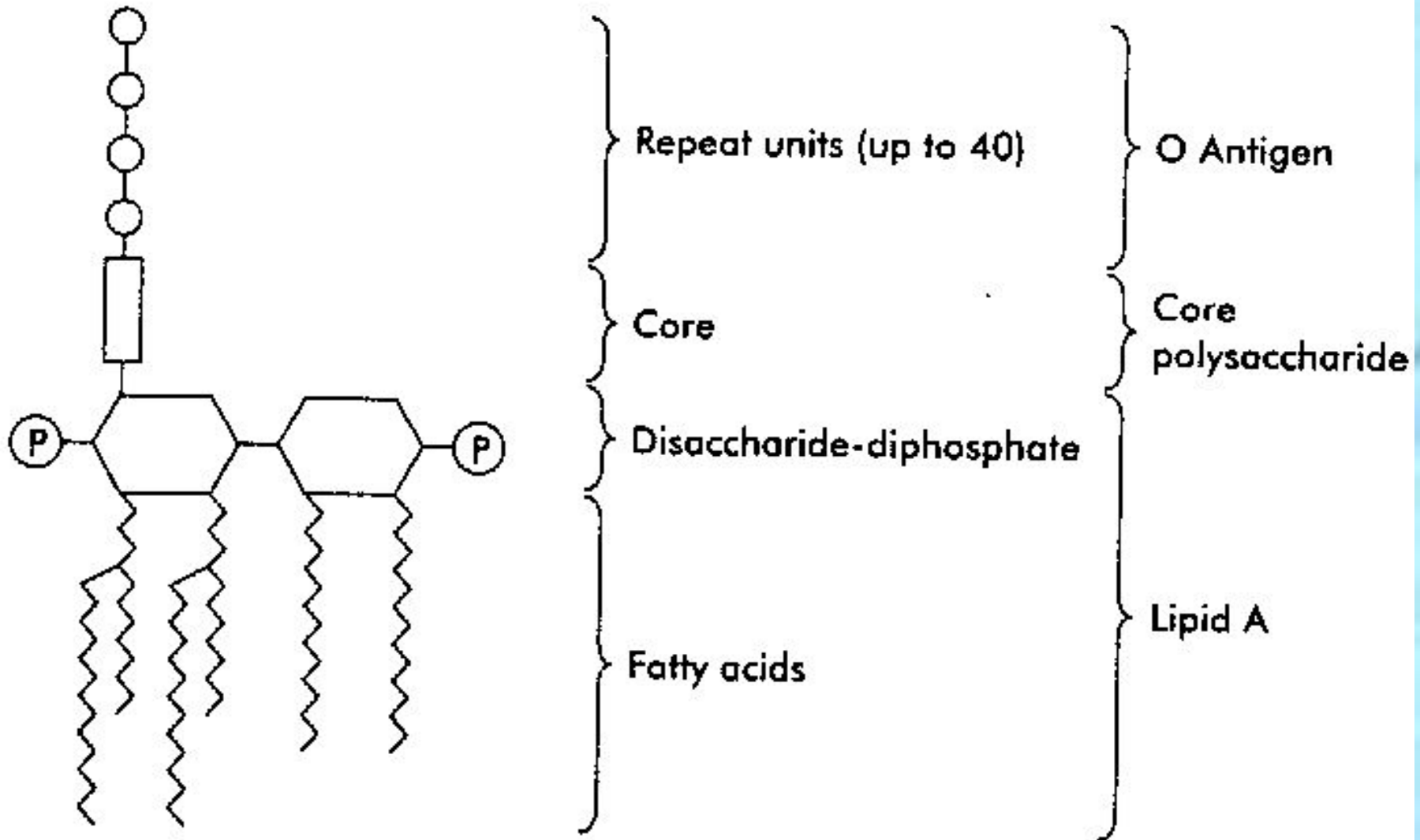
## EXOTOXIN

1. Released from the cell before or after lysis
2. Protein
3. Heat labile
4. Antigenic and immunogenic
5. Toxoids can be produced
6. Specific in effect on host
7. Produced by gram-positive and gram-negative organisms

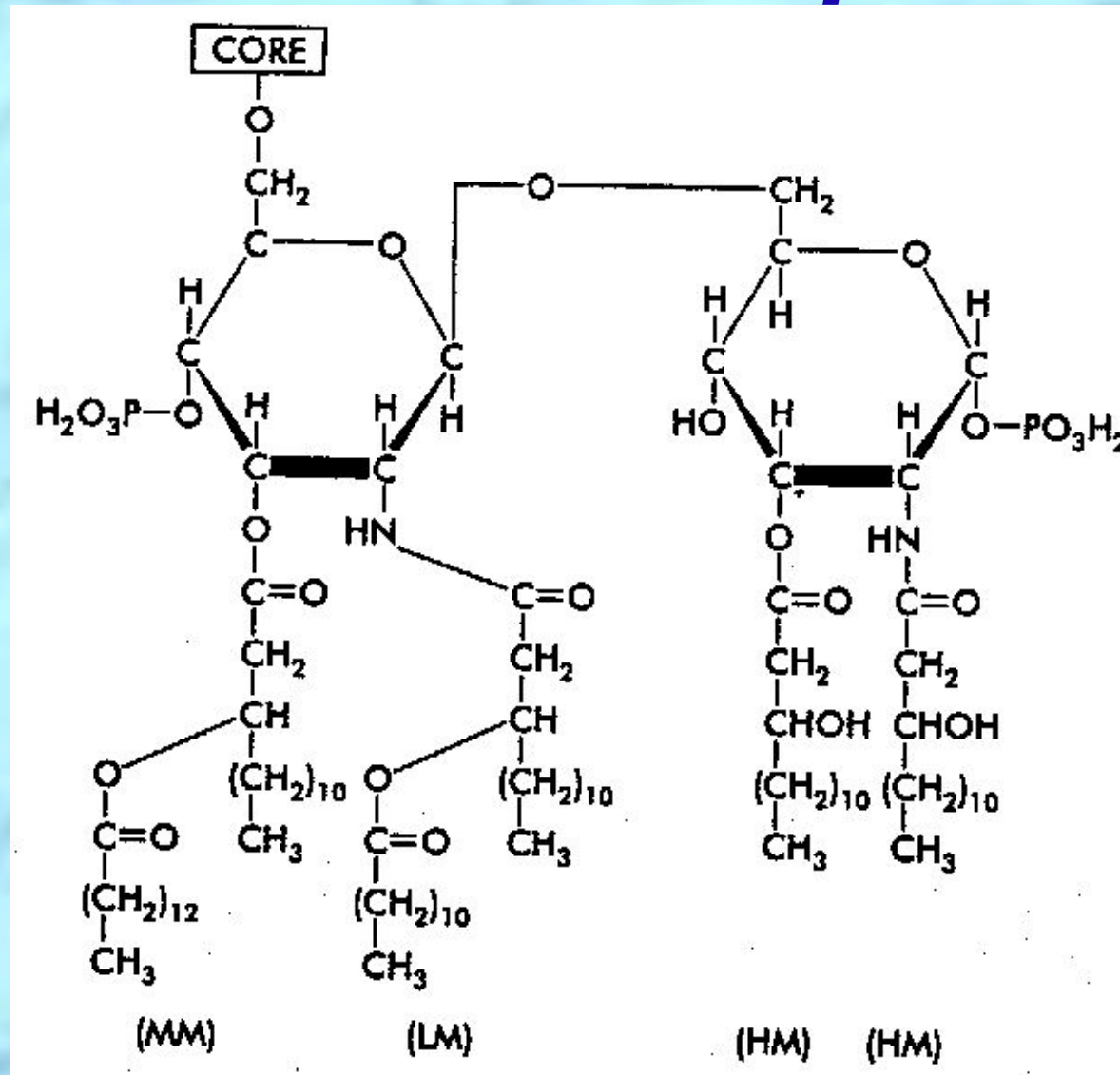
## ENDOTOXIN

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2. Endotoxin is LPS; Lipid A is toxic component
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# Structure of Lipopolysaccharide



# Structure of Lipid A



□ Hydrophobic Lipid A is endotoxic component

# Structure of Core Polysaccharide

Glu-GlcNAc

Gal

Glu-Gal

Hep

Hep-P-P-Eth·N

KDO

KDO-KDO-P-Eth·N

KDO = Keto-deoxy-octulonate

Hep = L-Glycero-D-mannoheptose

HM =  $\beta$ -Hydroxymyristic acid (C<sub>14</sub>)

LM = Lauroxymyristic acid

MM = Myristoxymyristic acid

Eth·N = Ethanolamine

Glu = Glucose

GlcNAc = N-Acetylglucosamine

Gal = Galactose

□ KDO is distinctive sugar moiety in core polysaccharide

# *Repeat Units of O Antigen Side Chain*

**Example: (Repeated up to 40 times)**



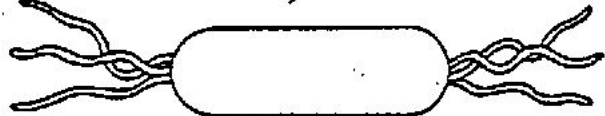
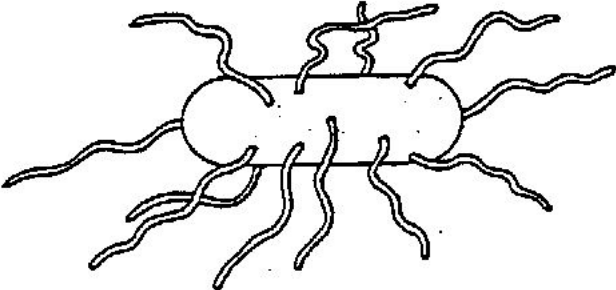
**Mannose — Abequose**

**Rhamnose**

**Galactose**

□ **Heat stable** O antigen is often used to **serotype**

# ***Taxonomic Descriptions of Prokaryotes Based on Numbers and Arrangements of Flagella***

<b>Terminology</b>	<b>Flagellum arrangement</b>
Atrichous Monotrichous	No flagella One flagellum at one end 
Amphitrichous	One or more flagella at each end 
Lophotrichous	Tuft of Δ Two or more flagella at one or both ends 
Peritrichous	Flagella surrounding the cell 

# ***Taxonomic Descriptions of Prokaryotes Based on Numbers and Arrangements of Flagella (cont.)***

## **Polar**

**Monotrichous**, a single flagellum at one or both ends of the cell

**Multitrichous**, two or several flagella at one or both ends of the cell

## **Lateral**

Flagella arise predominantly from the **middle pole** of the cell

**Monotrichous**, one flagellum

**Multitrichous**, several flagella in the form of a tuft originating from the midportion of the cell

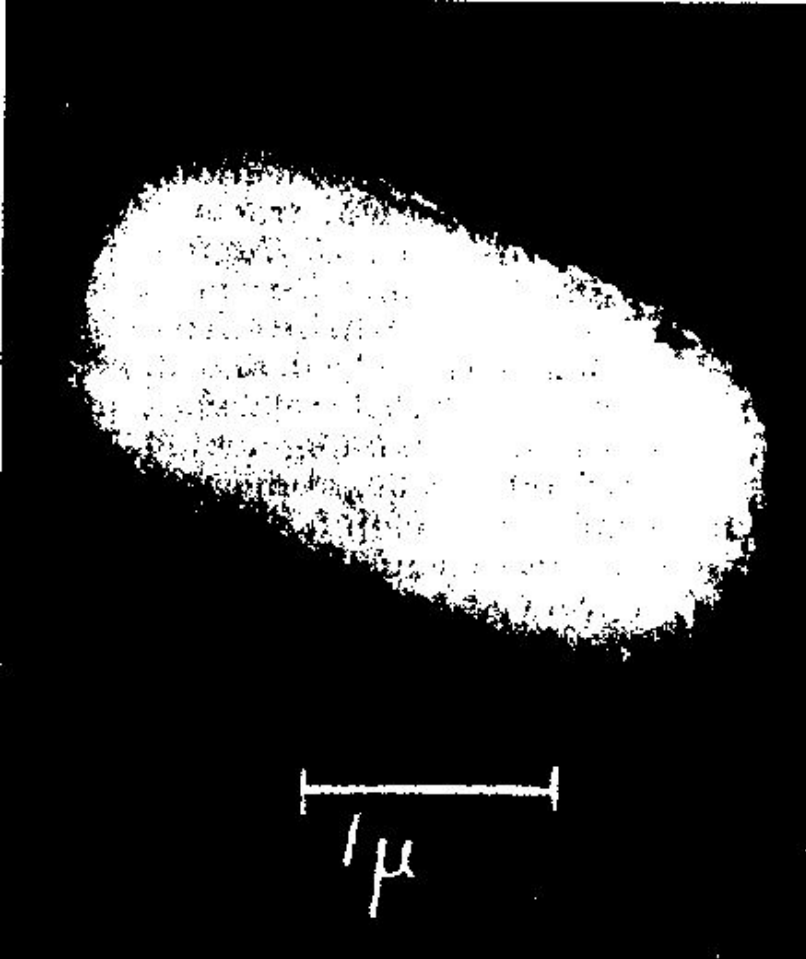
## **Peritrichous**

**Random**, haphazard arrangement of flagella scattered around the bacterial cell

## **Mixed**

Two or more flagella exhibiting distinctly different physical properties in different regions of the bacterial cell





***Escherichia coli***

## ***Proteus vulgaris***

- Hypermotile
- Swarming growth



# Family Enterobacteriaceae

	Genus	No. of species
	<i>Citrobacter</i>	4
	<i>Edwardsiella</i>	4
Certain <i>E. coli</i> strains can be considered true pathogens →	<i>Enterobacter</i>	13
	<i>Escherichia</i>	5
True pathogen →	<i>Shigella</i> (nonmotile)	4
	<i>Ewingella</i>	1
	<i>Hafnia</i>	2
	<i>Klebsiella</i> (nonmotile)	7
	<i>Kluyvera</i>	2
	<i>Morganella</i>	2
	<i>Proteus</i>	4
	<i>Providencia</i>	5
True pathogen →	<i>Salmonella</i>	7 subgroups
	<i>Serratia</i>	10
True pathogen →	<i>Yersinia</i>	11

# ***Medically Important Enterobacteriaceae***

***Citrobacter*** species

***Enterobacter*** spp.

***Escherichia*** spp.

***Klebsiella*** spp.

***Morganella*** spp.

***Proteus*** spp.

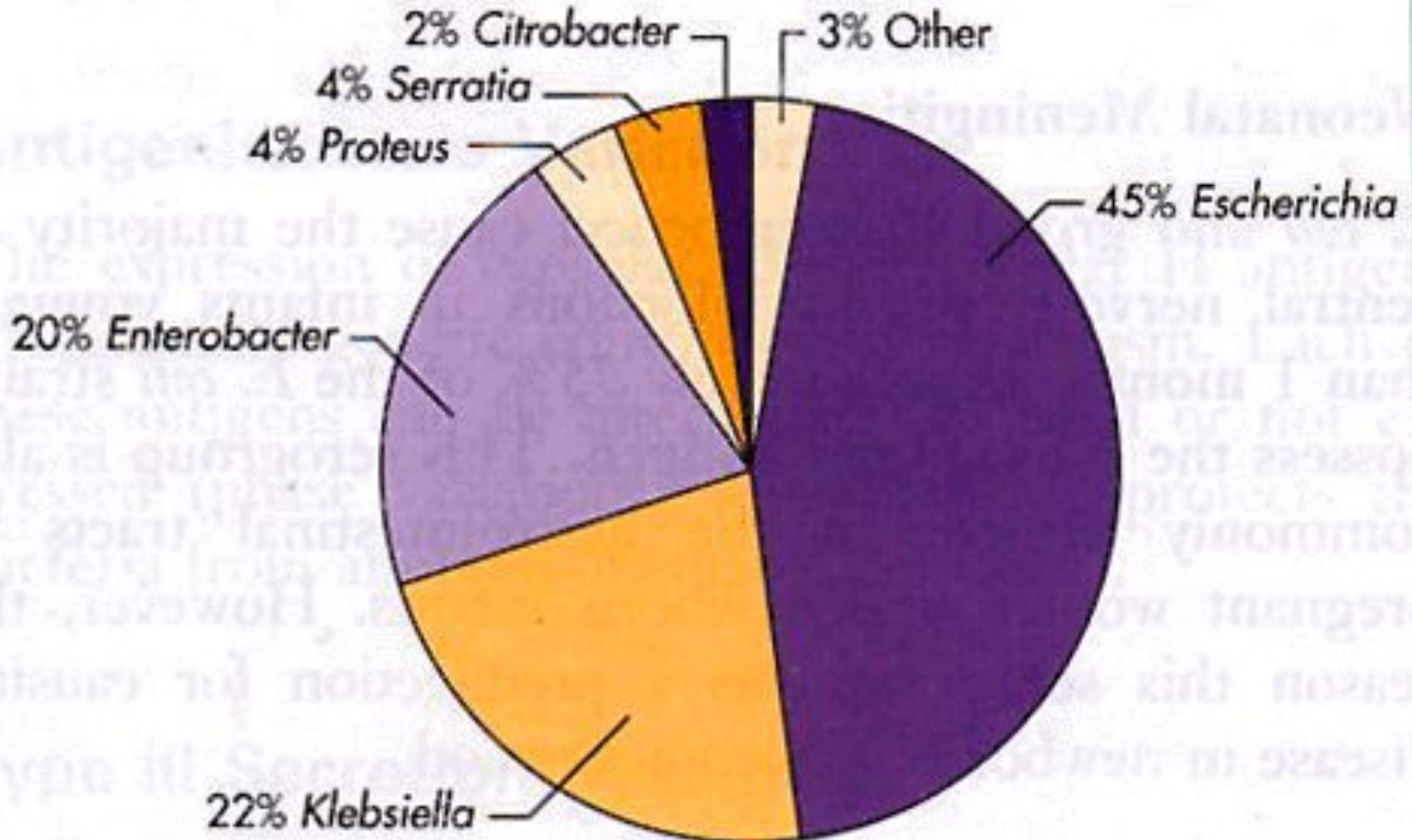
***Salmonella*** spp.

***Serratia*** spp.

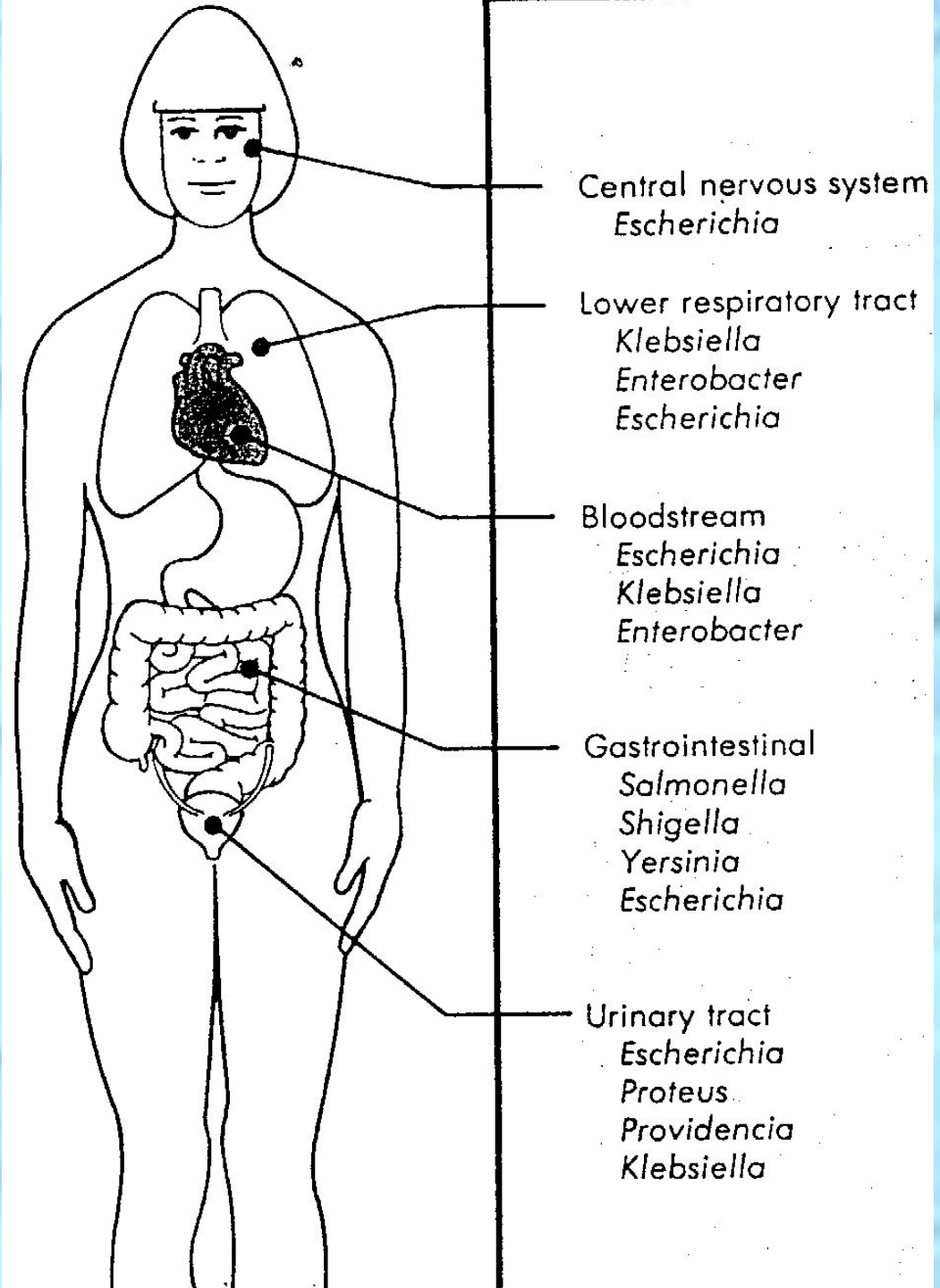
***Shigella*** spp.

***Yersinia*** spp.

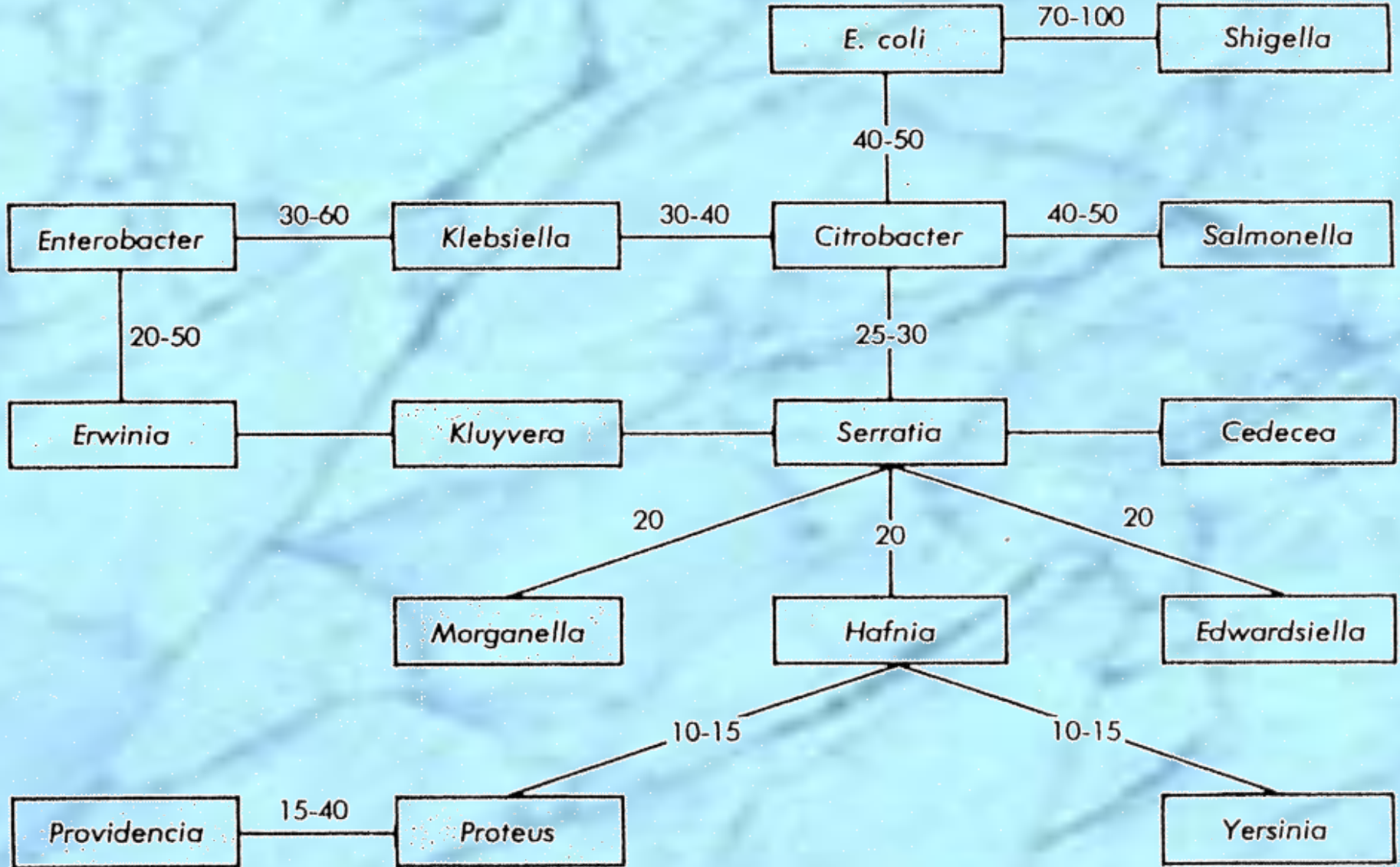
# *Incidence of Enterobacteriaceae Associated with Bacteremia*



# ***Sites of Infections with Members of the Enterobacteriaceae***



# DNA Relatedness Among Common Enterobacteriaceae





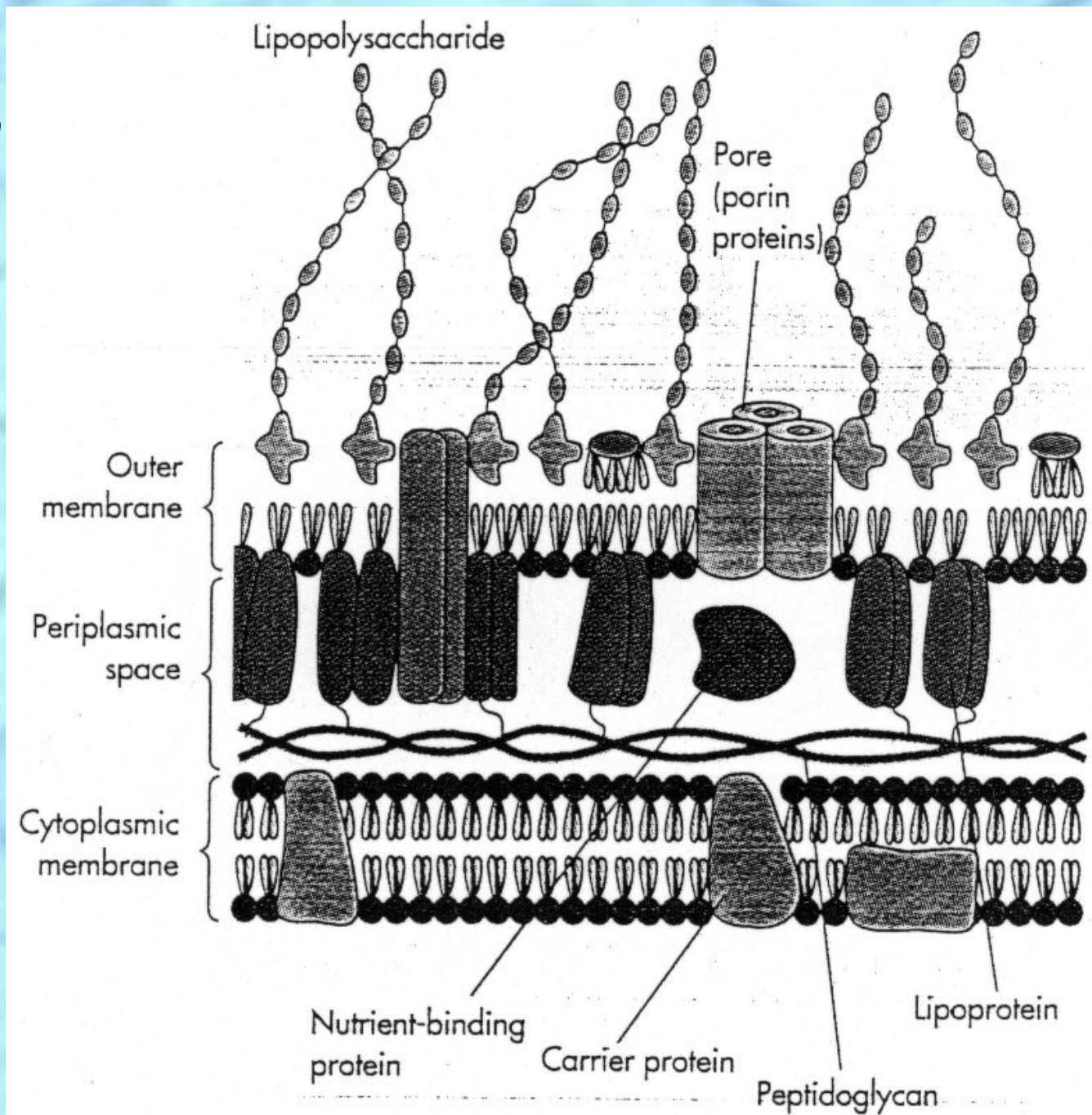
***REVIEW***



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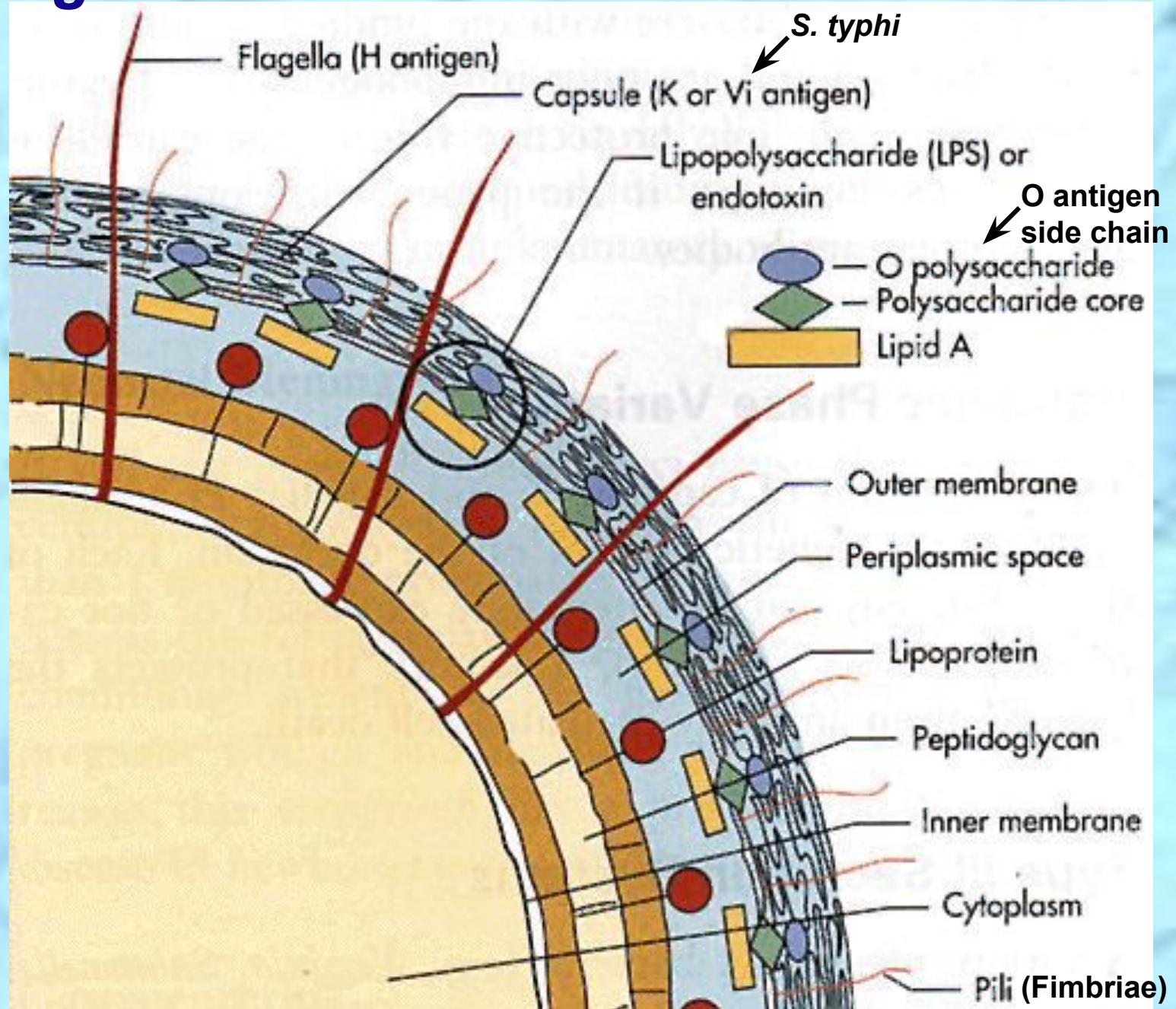
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# Gram-Negative Cell Wall



REVIEW

# Antigenic Structure of Enterobacteriaceae



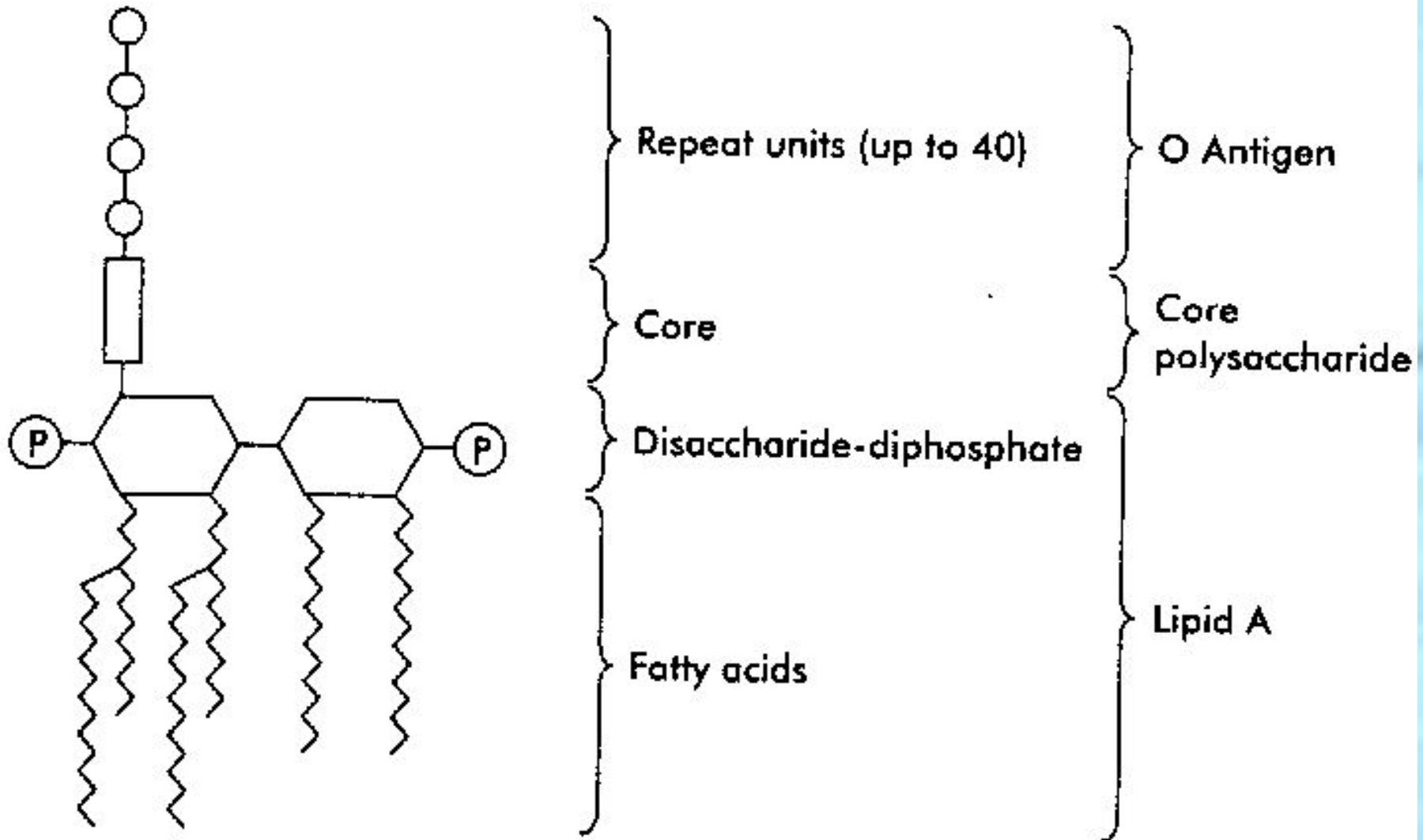
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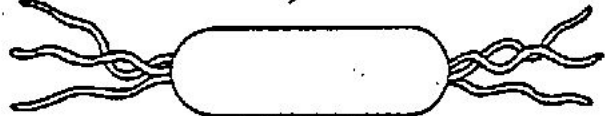
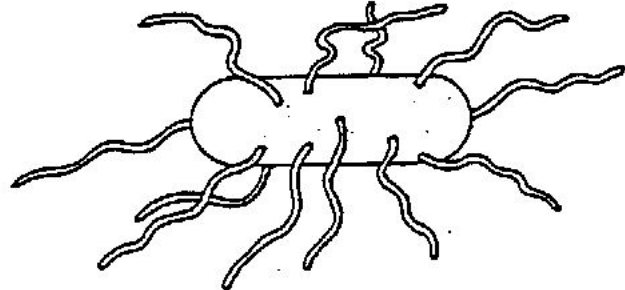
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